INDUSTRIAL MEDICINE AND SURGERY

Volume 24 JULY 1955 Number 7

LEAD POISONING

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1. Rubin, M.: Biological Action of Versene, from Symposium on Complexing Agents, presented at the University of Chicago, Feb. 22, 1951.
2. Sidbury, J. B., Jr., Bynum, J. C., and Fetz, L. L.: Effect of Chelating Agent on Urinary Lead Excretion, Comparison of Oral and Intravenous Administration, Proc. Soc. Exper. Biol. & Med. **82**:276 (Feb.) 1953.
3. Cotter, L. H.: Treatment of Lead Poisoning by Chelation, J.A.M.A. **155**:906 (July 3) 1954.
4. Bradley, J. E., and Powell, A. M., Jr.: Oral Calcium EDTA in Lead Intoxication of Children, J. Pediat. **45**:297 (Sept.) 1954.

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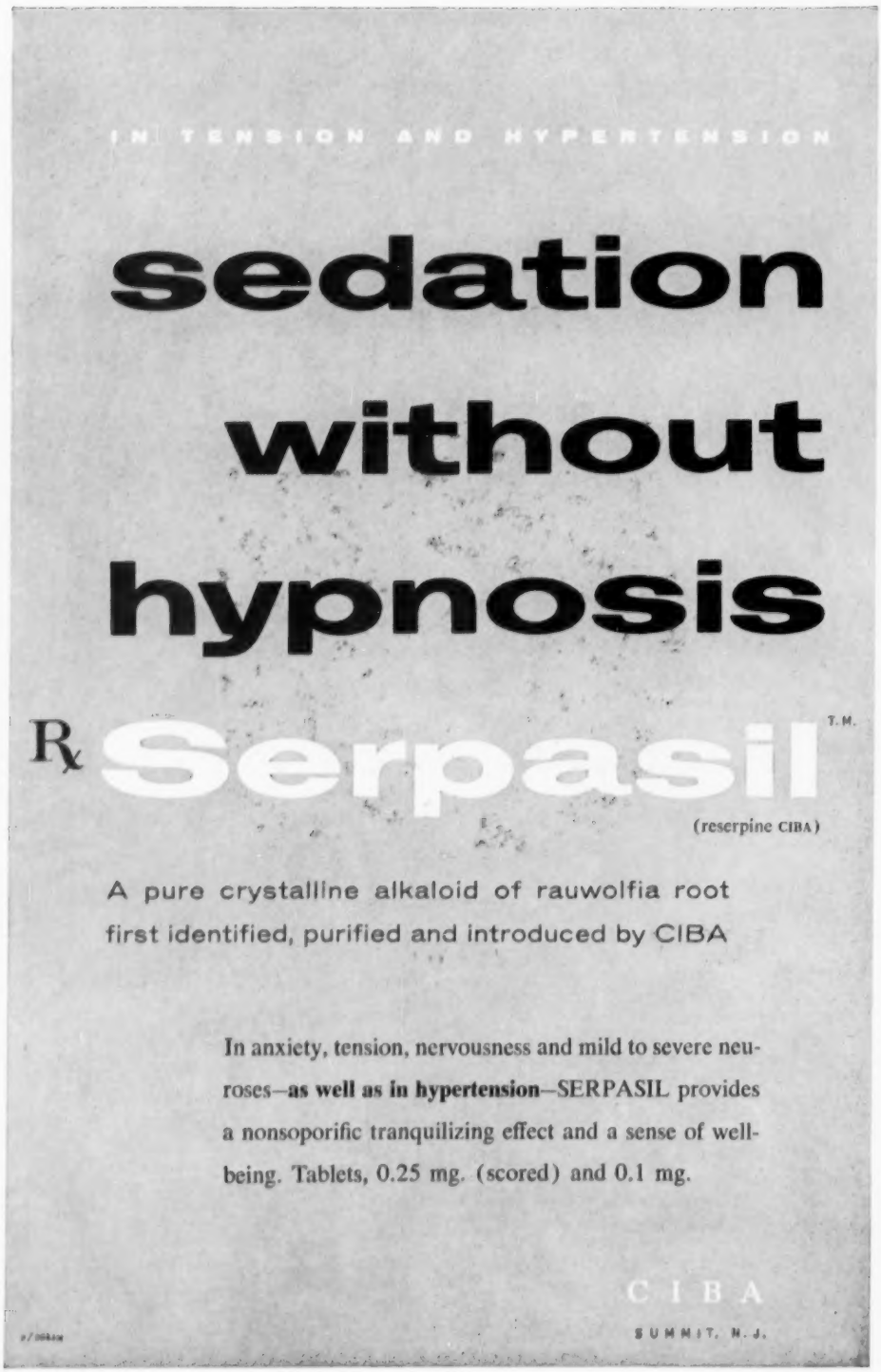
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This Journal is dedicated to the advancement of sound industrial medicine, including the surgery of industrial trauma. To that end its varying contents will embrace scientific papers, reports, digests, news items and official statements, together with editorial comment. The editorial policy is to avoid undue censorship. Some contributions ably prepared will be published although contravening the personal opinions of the editors. Care will be exercised in checking the accuracy of known facts, as printed, but in all other respects statements and opinions are those of the author and may not be shared by the editors. On any article, the editors reserve the right to comment favorably or otherwise, in the current or any subsequent issue. On this basis, contributions are invited. The opinions expressed in any contributions, including the editorials of this Journal, do not necessarily reflect the attitude or opinions of any associated organization.

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NORMAN L. CLAYBOURN, M.D., has been appointed Assistant Director of the Medical Department at Inland Steel Company's Indiana Harbor Works. Dr. Claybourn is a native of Pekin, Illinois. He received his M.D. at the University of Kansas School of Medicine in Lawrence and Kansas City, Kansas. After serving as a Captain in the Army Medical Corps in the European and Pacific Theaters during World War II, he entered private practice at Eldorado Springs, Missouri. Later he was in general practice at the Ft. Scott Clinic in Kansas. For the past three years he has been with the Procter & Gamble Defense Corporation at Amarillo, Texas, where he served as Medical Director. He is a member of the American Medical Association and the Industrial Medical Association.

W. HARRISON MEHN, M.D., has been appointed Medical Director of Commonwealth Edison Company, Chicago, following his return from military service. He succeeds B. F. LOUNSBURY, M.D., who will remain on the company's medical staff in a limited capacity. DR. MEHN became associated with Commonwealth Edison in 1950.

WILLIAM A. SAWYER, M.D., on May 15 was named recipient of the 1955 Albert David Kaiser Medal. The Albert David Kaiser Medal was established in 1939 in honor of DR. ALBERT D. KAISER, City Health Officer. The award is bestowed annually by the Rochester Academy of Medicine in recognition of outstanding achievement in medicine and public health. It

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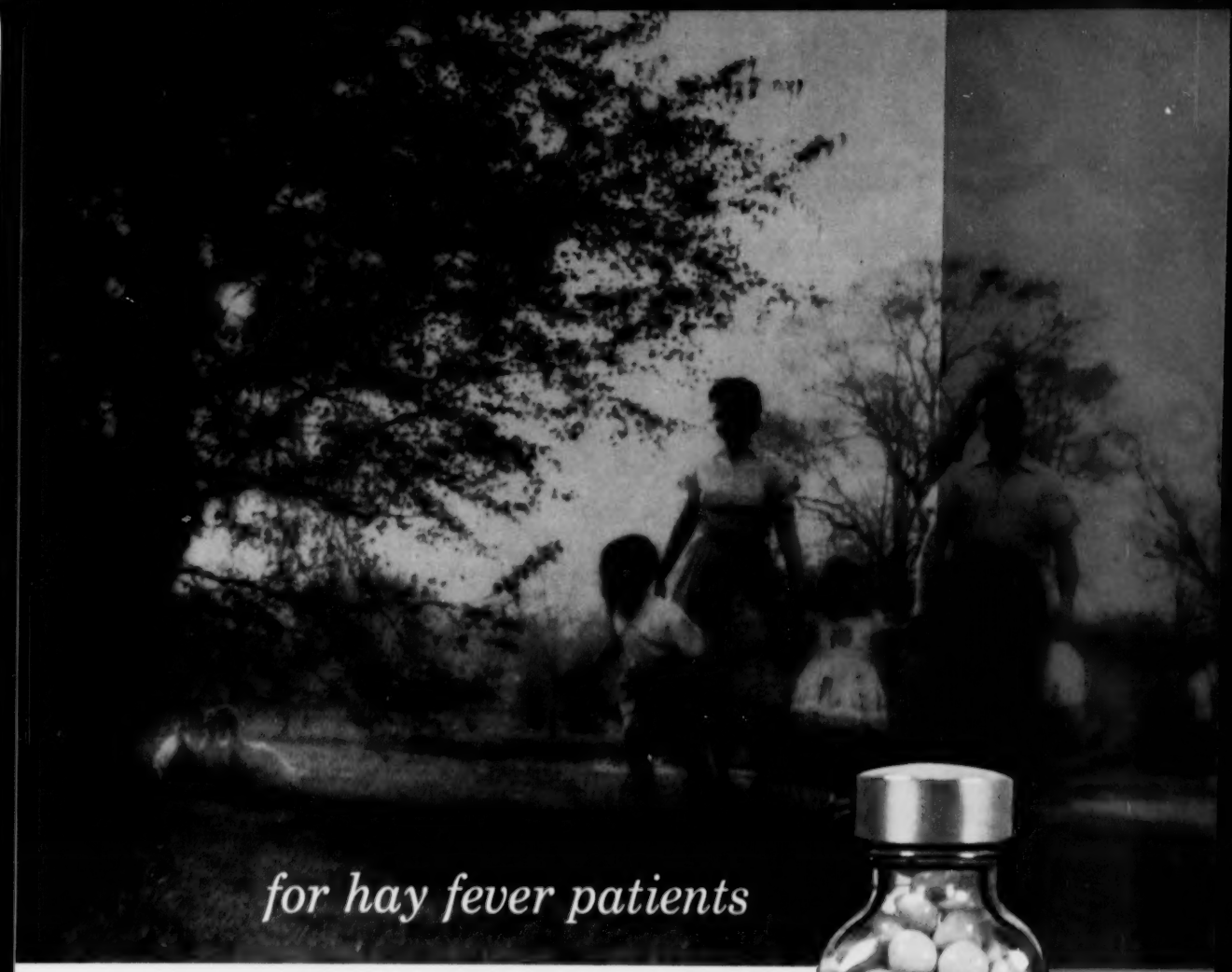

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Component Society of the Industrial Medical Association.

is regarded as the highest honor that can come to a Rochester physician from a local organization. Selection of DR. SAWYER was announced by DR. JOHN ROMANO, Chairman of the Academy Awards Committee. The Medal, with an accompanying citation, was presented at the Academy's Annual Meeting on May 24. According to DR. ROMANO, DR. SAWYER was cited "for his distinguished contributions and dedicated service to industrial medicine, and to the health and welfare of our community and nation."

VINCENT T. WILLIAMS, M.D., Kansas City, was honored on February 19 when the world premier of his composition "Corn and Counterpoint," was given at the Philharmonic Pop Concert. DR. WILLIAMS is the former Editor of *Missouri Medicine* and present Editor of the *Kansas City Medical Journal* of the KC Southwest Clinical Society.

—*J.A.M.A.*, June 11, 1955.

MELVILLE H. MANSON, M.D., Medical Director, American Telephone and Telegraph Company since 1943, resigned that position on May 5, 1955.

THE 1956 Congress on Industrial Health, sponsored by the AMA, will be held in Detroit (Sheraton-Cadillac Hotel), January 22-25, 1956. For program and full information, write CARL M. PETERSEN, M.D., 535 North Dearborn Street, Chicago 10.

CARL A. WILZBACH, M.D., Cincinnati Health Commissioner, announced on May 31 that his choice of a successor to JAMES P. HUGHES, M.D., formerly in charge of the Health Department's Industrial Health Program, is MITCHELL R. ZAVON, M.D., who is on leave of absence from the U.S. Public Health Service. The position has been vacant since DR. HUGHES resigned to accept a position with Ohio State University.

HAROLD A. VONACHEN, M.D., Medical Director, Caterpillar Tractor Company, at the Conference on the Modern Corporation and the Nation's Health, sponsored by the National Fund for Medical Education, at Chicago, in February, read a paper on "Medicine in Industry"—a well-rounded treatment of what he described as "a well-rounded medical program." This paper was published in *J.A.M.A.*, April 30, 1955.

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68th Annual Meeting, April 10-12, 1956, at the Drake Hotel, Chicago

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JOHN K. WILLIAMS, Executive Director, Birmingham Industrial Health Council, spoke at the Tenth Annual Greater Louisville Safety Conference, May 25, 1955, describing the purposes of the Council — "to provide preventive medical services to industrial and commercial firms in Birmingham" —and explaining that the cost of the program to the member firms is $3.65 a year for each employee, based on the average number of employees. The Birmingham plan now covers 250 industries and more than 40,000 workers. A similar Industrial Health Council, based on the Birmingham model, is under study in Louisville. It has received the endorsement in principle of the Health and Hospitals Committee of the Chamber of Commerce, and of the Associated Industries of Kentucky.

INDUSTRIAL physicians in Omaha, Nebraska, held their Third Annual Industrial Health Conference, June 9. The theme was "Human Maintenance in Industry," and the program was highlighted by the presentation by H. R. ATHERTON, M.D., Medical Director, Swift & Company, Chicago, who spoke on "Cardiacs in Industry." The Conference was sponsored by the Omaha Chamber of Commerce, the Nebraska State Medical Association, the Nebraska State Nurses Association, Associated Industries of Nebraska, Omaha Manufacturers Association and United Community Services.

THEODORE F. HATCH, Professor of Industrial Health Engineering, Graduate School of Public Health, University of Pittsburgh, had an article entitled "Proposed Program in Ergonomics—Human Engineering" in *Mechanical En-*

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gineering, May, 1955. Reprints may be obtained from Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13.

ROY G. CONRAD, M.D., has been named Assistant Medical Director, and GEORGE NAYMICK, M.D., has been appointed Assistant in Medicine and Surgery, for Weirton Steel Company, Pittsburgh.

DR. WILLIAM M. GAFAFER, Technical Adviser to the Chief of the Occupational Health Program, Public Health Service, U.S. Department of Health, Education, and Welfare, has been appointed by the Industrial Hygiene Foundation of American to serve on its Research Advisory Council. DR. GAFAFER has been associated with the Occupational Health Program of the Public Health Service for over 20 years and is nationally known, especially for his industrial sickness absenteeism studies. He has had long and varied experience with all types of worker health problems and enjoys a close working relationship with the different professional disciplines in the field of industrial hygiene. He was awarded his degree as Doctor of Science at Johns Hopkins University in 1929. Prior to entering the Public Health Service, he was affiliated with Columbia and Johns Hopkins Universities. He is a member of the Society of the Sigma Xi, Washington Academy of Sciences, International Association for Dental Research, American Conference of Governmental Industrial Hygienists, and American Industrial Hygiene Association, among other organizations. He has published over 150 technical papers and edited numerous books in public health and related fields.

JUNE 2, 1955, the Medical Science Building of New York University-Bellevue Medical Center was dedicated. Twelve internationally known scientists were awarded the Honorary Degree of Doctor of Science. Following this, HAROLD BRANDALEONE, M.D., President of the Alumni Association of the New York University College of Medicine, and Medical Director of the Third Avenue Transit System, and the United Parcel Service, New York City, presented JONAS E. SALK, M.D., of the Class of '39 Alumni, with a special meritorious gold medal for his outstanding achievement in the control of poliomyelitis.

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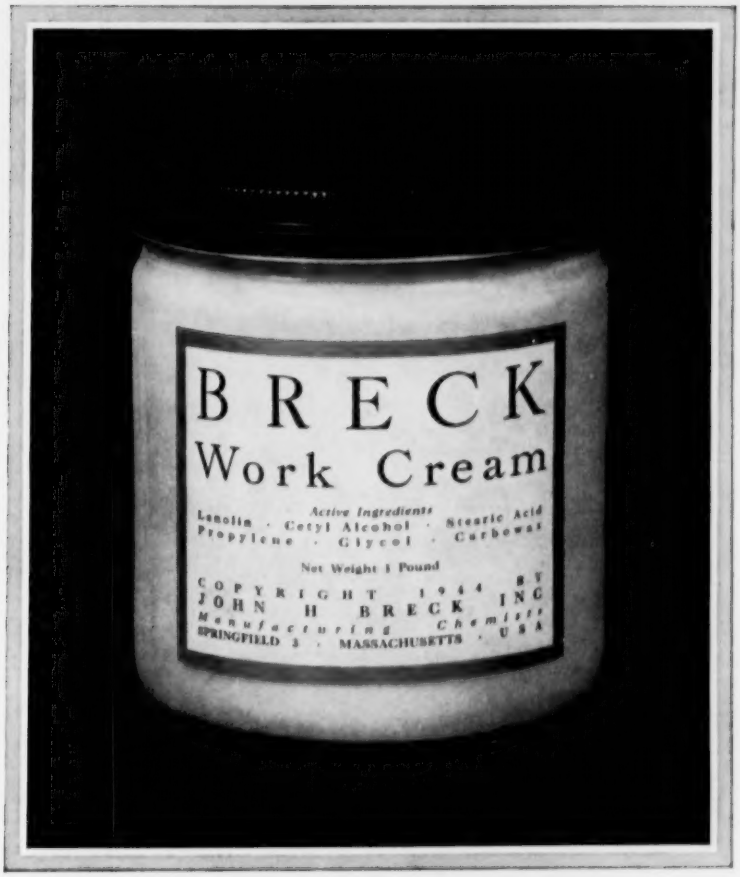

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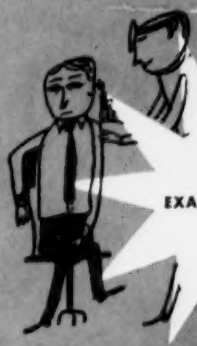

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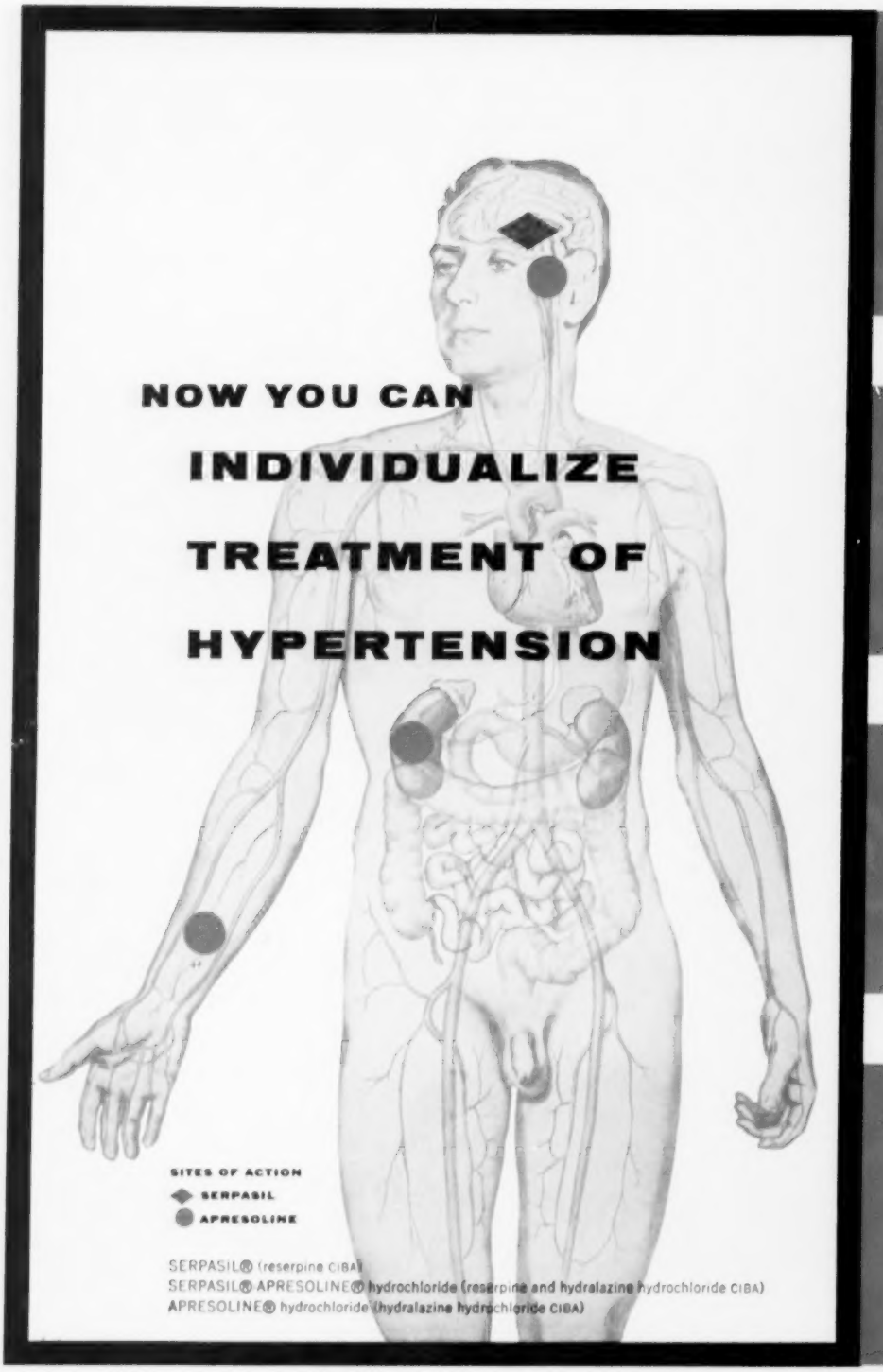
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* *Cronk, G. A., and Naumann, D. E.: Antibiot. & Chemother. 5:64 (Feb.) 1955.*

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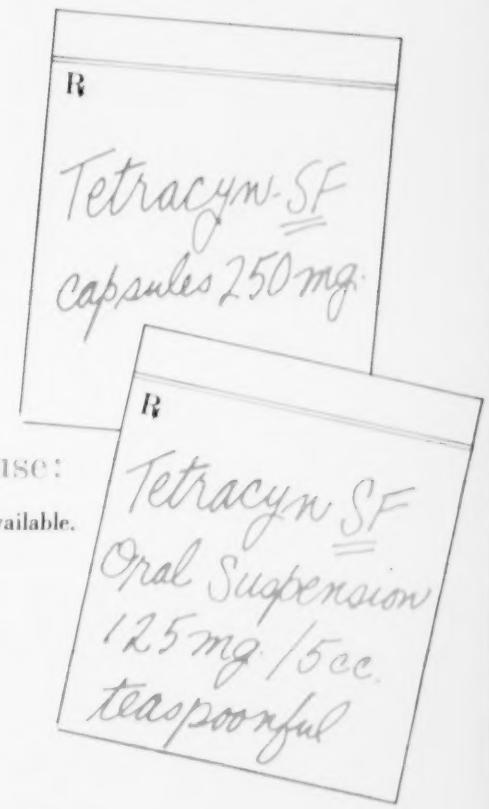

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1. Pollack, H., and Halpern, S. L.: Therapeutic Nutrition, Prepared in Collaboration with the Committee on Therapeutic Nutrition, Food and Nutrition Board, National Research Council, Washington, D. C., 1952.
2. Marti-Ibañez, F.: Antibiotic Med. *1*:247 (May) 1955.
3. Dumas, K. J.; Carlozzi, M., and Wright, W. A.: Antibiotic Med. *1*:296 (May) 1955.

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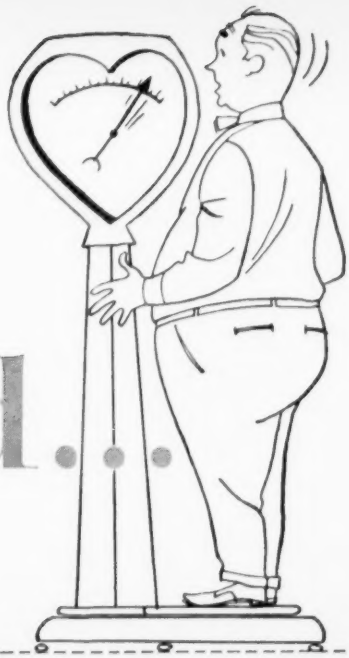

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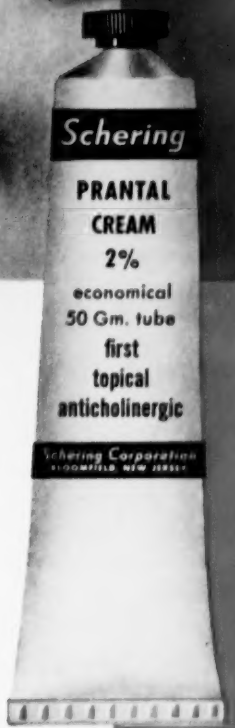

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1. Silbert, N. E.: Ann. Allergy *10*:328 (May-June) 1952

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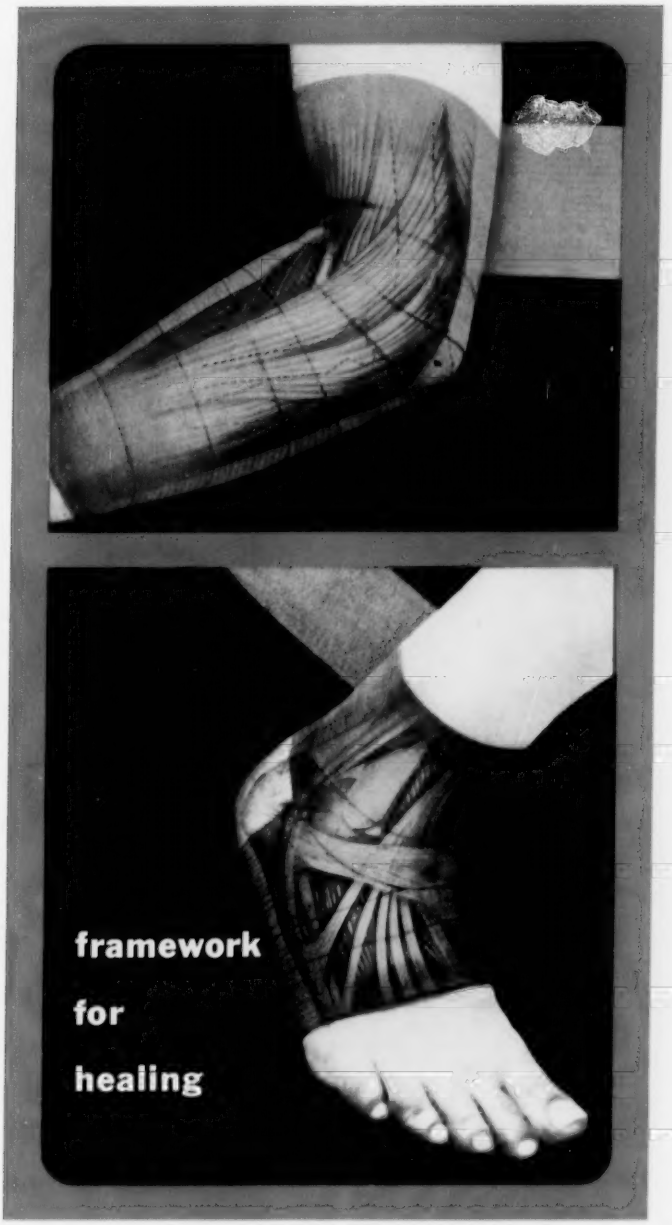

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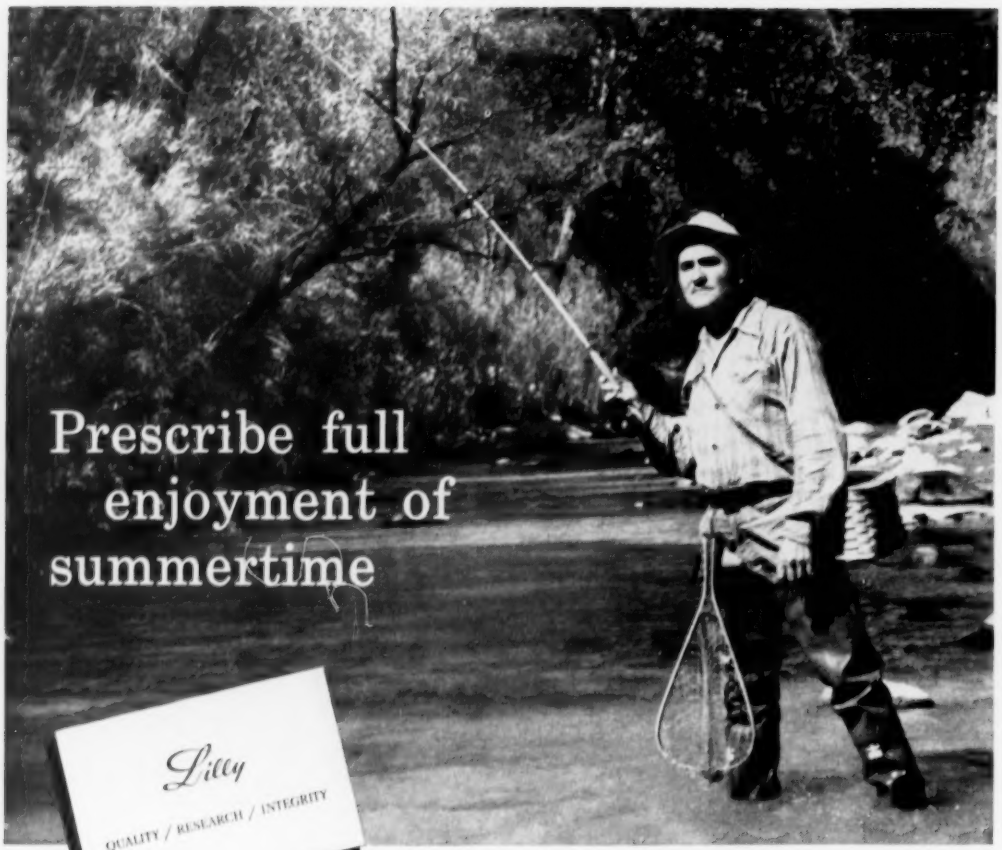

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INDUSTRIAL MEDICINE AND SURGERY

JULY, 1955

Chelating Agents

HARRY FOREMAN, M.D.
Staff Member, Los Alamos Scientific Laboratory
of the University of California, Los Alamos, New Mexico

A METAL chelate is a special form of a complex or coordination compound. A coordination compound is one in which a metal ion and an organic molecule are bound together by a coordinate valence, a special type of binding wherein the organic portion (or donor) contributes both electrons necessary to form the bond. Inorganic atoms can also be donors, so that entirely inorganic complexes also occur.

In a complex or coordinate type of structure such as organic metal chelates, the metal loses its original characteristics as an ion. Thus, for example, Ca ion in combining with citric acid forms a complex in which the characteristic effects of the Ca ion are no longer apparent, i.e., it will no longer be precipitated by alkaline phosphate or coagulate plasma, nor will it exert the typical effects on nerve and muscle. When a complexing agent combines with a metal ion so that two or more of the functional groups of the organic molecule attach to the metal ion and one or more rings are formed, the resulting compound is termed a chelate. Nearly all of the metals in the periodic system form complexes or chelates. In general, organic compounds which are likely to be chelating agents are those which contain N, O or S attached to an active H. Fig. 1 shows the structure of ethylenediaminetetracetic acid (EDTA), a typical chelating agent. The upper formula shows a proposed type of binding with Ca.

Calcium ion forms electro-valent bonds with either one divalent anion or two monovalent anions. In coordinate valence binding, Ca^{++} has the possibility of combining with four, six or eight atoms. It has not been established which is the usual one for Ca. In the upper formula Ca is shown with a coordination number of 4. A more likely structure is shown in Fig. 2 in which Ca has a coordination number of 6, the common coordination number for most metals. In Fig. 3 may be seen dimercaprol (B.A.L.), a chelating agent of biological importance. The structure it forms in combining with metal ions has never been established. In the terminology of the chelation chemists it is tridentate ligand since it has three groups for binding with a metal ion, i.e., Hg^{++}. When combining with a coordination number of 6, two molecules of the organic compound would likely be involved with one metal ion.

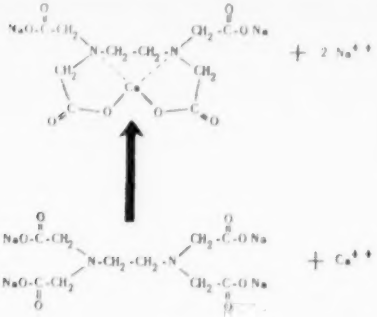

Fig. 1.
Structure of tetra sodium ethylenediaminetetracetate and the corresponding calcium chelate.

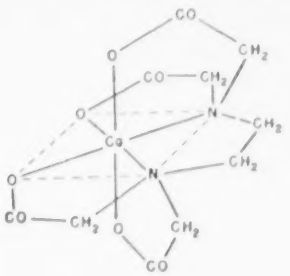

Fig. 2.
Another proposed structure of Ca EDTA.

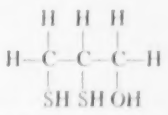

Fig. 3.
Dimercaprol (B.A.L.)

The combination of a metal ion with an organic molecule in a chelate structure often confers new properties which are not apparent in the metal ion or organic moiety when each is considered alone. These are the means used to determine the formation of chelates. Among these

This report was prepared from a transcription of a talk presented at the Second Annual Conference on Plutonium, Radium and Mesothorium held at the University of Utah College of Medicine in Salt Lake City, Utah, June 19, 1954. The work represented by the report was done under the auspices of the Atomic Energy Commission.

changes are color (many dyes owe their color to chelate formation), electrical conductivity (as a rule conductivity drops as more and more chelate is formed in solution), changes in solubility, chemical reactions, magnetic susceptibility, and others. Of great interest are the situations in which chelate structure formation confers biological activity. Hemoglobin, catalase, carbonic anhydrase, various keto acid carboxylases, cytochromes, arginase, phosphatase and phosphate-transferring enzymes all are metal chelates or are postulated to exert their biochemical activity through the reversible formation of metal chelates or complexes.

Applications of Chelating Agents

IN VIEW of the powerful effects these materials naturally exert in the body, it is not surprising that attempts have been made to use synthetic chelating agents for various medical and investigative purposes. For many years advantage has been taken of the solubility characteristics of chelates as means of introducing metals into the body as an attempt at therapy. Preparations for parenteral administration of Fe, Ca, Mg, Bi, Sb and Au as the citrates, gluconates, salicylates, and thiomalates, to mention just a few, all are chelates or complexes.

In recent years considerable research has been carried on in which synthetic chelating agents have been used as competitors for metals in biological systems as a means for studying enzymes. For instance, Crismon[3] at Stanford found that action of epinephrine on precapillary sphincters could be inhibited by ferritin and Fe^{++} ion, and that certain chelating agents such as rutin and EDTA reverse this effect. From this, Crismon concludes that Fe^{++} activated the epinephrine-destroying enzymes in the system and that tying up the Fe^{++} in chelate structure removed this potentiation. EDTA not only prevented the inhibition of the added Fe but enhanced the activity of the system even when no Fe was added. Crismon states this is due to the EDTA tying up trace quantities of Fe naturally associated with the epinephrine-destroying enzymes.

The system provides a means for comparing the relative affinities (or, looking at it another way, the relative stability constants) of the naturally occurring chelates with the added ones. One could reason that although the Fe in ferritin is tied up as a complex it still exerts the same effect as ionic Fe and hence the epinephrine-destroying enzymes must remove the Fe from the ferritin. Rutin and EDTA tie up the Fe ion so that it does not exert its effect on the system; therefore these are stronger chelates than the naturally occurring chelate. EDTA but not rutin will remove trace Fe naturally bound with the enzyme, so EDTA is stronger than rutin in this system. The order of relative complexing affinity listed in decreasing strength then is: EDTA > rutin > epinephrine-destroying enzyme > ferritin.

In recent years attempts have been made to remove metal ions from the body by the use of chelating agents. Among the first of the chelating agents considered for heavy metal poisoning is citric acid. Kety,[5] from stability constant considerations, indicated that theoretically citric acid should be effective in hastening the elimination of Pb. However, clinically this has not turned out to be the case. This may be due to the fact that citrate is rapidly destroyed in the body. As a naturally occurring metabolite, like acetate, it is probably formed in prodigious quantities during the course of a day, but at any one time there is never a large quantity present, relatively speaking. The low equilibrium levels are probably maintained by a rigidly functioning homeostatic mechanism and added citrate is rapidly destroyed in the maintenance of homeostasis.

Holland and co-workers at Columbia[7] reported on a series of five patients in which a chelating agent, EDTA, was used to pull Ca from the body. Typical of these cases is one which involved a 58-year-old female afflicted with extensive osteolytic metastases associated with carcinoma of the breast. On entry she presented the characteristic picture of a moribund terminal patient. Among other grossly abnormal findings she ran a serum calcium of 19 mg. per 100 cc. She was given Na EDTA intravenously in progressively increasing doses with little effect on serum calcium level until a dose level of 20 gm. in 15 minutes was given. She roused from her stupor, became very restless, and complained of an urge to defecate. Serum calcium levels dropped from the original 19 mg. percent to 8 mg. percent. Treatment was stopped. Two hours later the serum calcium level was up to 16 mg. per 100 cc. Actually the treatment made little difference to the patient since she died two days later. This and the other cases, where in each instance the serum calcium levels rose again, well illustrate the futility of trying to lower the serum concentration of an ion for which the body has strong homeostatic powers, even though one has an effective agent for doing this.

In another experiment a chelating agent, Na diethanolamine acetate (Fe-3 specific) was used

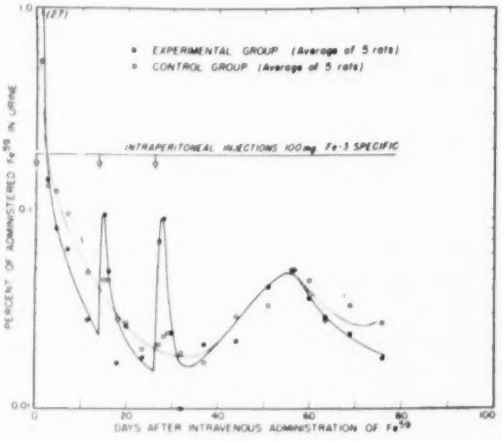
EXPERIMENTAL GROUP (Average of 5 rats)
CONTROL GROUP (Average of 5 rats)
INTRAPERITONEAL INJECTIONS 100mg Fe-3 SPECIFIC
PERCENT OF ADMINISTERED Fe59 IN URINE
DAYS AFTER INTRAVENOUS ADMINISTRATION OF Fe59

Fig. 4.
Effect of Na Diethanolamine acetate on urinary excretion of iron.

to pull out Fe^{59} which had been injected intravenously into rats (Fig. 4).[4] There was approximately a fourfold increase in urinary excretion each time the agent was injected intravenously. It is interesting that the effect lasted only a day or so, indicating that the material turns over rapidly in the body. Probably this is not a sufficient increase to be useful in hemochromatosis, but it does indicate an approach to treatment in an otherwise apparently hopeless disease. It has recently been shown that the regulatory mechanism for the absorption of Fe in the gut is impaired in hemochromatosis and that large quantities of Fe pass into the blood in such afflicted individuals. It may that chelating agents which form highly insoluble chelates with Fe, such as salicylic acid and Na phytate when given by mouth, might keep Fe in sufficiently low concentration in the gut to prevent increase in body stores of the metal ion.

As indicated earlier, B.A.L. is a chelating agent of considerable usefulness in pulling remaining metals from the body, in particular, Hg, As and Bi. Not only does it deplete the body rapidly of the metal ion but it also alleviates the associated symptoms, a factor of importance not always seen in this type of therapy. It is not useful in Pb poisoning. The only radioactive material which currently constitutes a health hazard for which B A.L. has been found efficacious is Po.

Among other chelating agents used for biological purposes are Na pyrocatechol disulfonate and Schubert's aurintricarboxylic acid and salicylic acid.[13] Sodium pyrocatechol disulfonate has been tried in the treatment of saturnism by Italian workers.

EDTA for Removal of Heavy Metals

IN THIS Laboratory Ca EDTA is the compound with which the most work has been done, and in many respects it has proved almost ideal.

EDTA forms very stable chelates with most metal ions. The stability constants of a few metals of special interest are presented in Table I. Comparison with citric acid is given to indicate how strong a binding is formed with EDTA, in some instances as much as 10 orders of magnitude greater. The stability constants for Th^{+4} and Pu^{+4} are 23.2 and 24 respectively, exceedingly high values. The constant for Pu was obtained from calculation, i.e., from $\frac{Z}{r}$ and $\frac{Z}{(r+2)^2}$ plots.[9] From these stability constants, reasonable predictions about the ability of the agent to pull certain metals out of the body can be made, although stability constants as determined in the test tube do not tell the whole story by any means. One could predict, for instance, that Sr and Ba would not be removed from the body by EDTA.

The stability constant for Ra has not been determined but it can readily be predicted that the value is lower than that for Ba (from the fact that the ionic radius of Ra^{++} is larger), and that Ra also would not be removed by EDTA.

Because of the higher stability constant for Ca, it will be removed preferentially to the other alkaline earth metals. In fact, whenever EDTA is introduced into the body as the Na salt, serum Ca^{++} concentration falls and hypocalcemic tetany will result if the administration is continued rapidly enough in large enough dose. It is for this reason that the drug is used as the Ca chelate. In this way a negative Ca balance is prevented, but the material still is effective with such ions as Pb^{++} and Pu^{+4} owing to the higher stability constants of the latter. These ions will displace Ca from combinations with EDTA because of the greater affinity of the agent for the ions which form more stable compounds.

TABLE I.
STABILITY CONSTANTS OF EDTA AND CITRATE

EDTA	Log K_1	Citrate	Log K_1
Mg EDTA	8.69		
Ca EDTA	10.59	Ca Citrate	3.22
Sr EDTA	8.63		
Ba EDTA	7.76		
Pb EDTA	18.2	Pb Citrate	5.7-6.5

Although it is unlikely that a metal which forms a weakly bound combination with a chelating agent will be removed from the body by this agent, it does not necessarily follow that a metal which yields a high stability constant with the agent will be removed. The chelating agent must compete with naturally occurring binding forces whether these be insoluble crystalline material in the skeleton, the forces by which the reticuloendothelial system binds materials (whatever they are), or the many naturally occurring complexing or chelating agents, and it is the net difference in binding forces that is important. For this reason it is felt information on the relative binding affinities of agents for various metals in biological systems under physiological conditions is of the greatest importance and value. One can glean this information by devious means such as indicated earlier in the work of Crismon. Rubin[10] (at Georgetown) has estimated relative affinities in the body from toxicity studies. He found that Ni^{++} is 70 times as toxic as its EDTA chelate; Ca^{++}, 100 times as toxic; and Cu^{++} and Be^{++}, four times as toxic as their chelates. He interprets this as an indication of the more powerful binding of the artificial agent as compared to the many naturally occurring complexing agents. If the latter were stronger, the EDTA combination would be just as toxic as the free ion.

In summary, it is most desirable that the agent form strong binding with the metal to be removed, and this binding should exceed natural binding forces. The metal to be removed must have a higher stability constant than essential metals in order that the latter not be depleted. EDTA meets these demands.

There are several other requirements for a chelating agent to be useful for therapeutic purposes. It is essential that the metal chelate formed in the body be readily excreted, and for this to occur it is highly desirable that water-soluble chelates be formed. In addition, it is important that the agent not be broken down in the body,

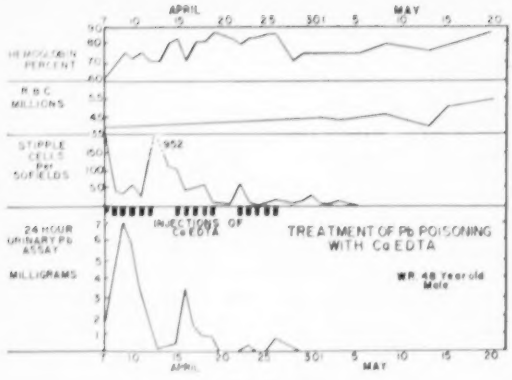

Fig. 5.
Treatment of Pb poisoning with Ca EDTA.

as was discussed with reference to citric acid, and of course the agent must not be toxic, that is, there should be a wide range between therapeutic dose levels and toxic dose levels.

Ca EDTA is a relatively non-toxic drug. Metabolic studies using C^{14}-labeled material indicate that it passes through the body unchanged. It is excreted via the kidney by both glomerular filtration and tubular excretion. The turnover time from the blood is approximately one hour after intravenous administration and one and a half hours after intramuscular injection. It quickly mixes with almost all of the body water, except that it does not pass into the red cells and passes relatively slowly into the spinal fluid compartment. It is poorly absorbed from the gastrointestinal tract.[5]

There have been many cases of lead poisoning treated with EDTA by workers all over the country.[1,6,11,12] The most spectacular and favorable results have occurred in children with Pb encephalopathies, where the use of the drug produced very satisfactory alleviation of convulsions and coma. In adults the use of the drug was followed by a manyfold increase in Pb urinary excretion and, in a number of instances, by objective signs of increased well-being of the patient, i.e., decrease in coproporphyrins and stipple count and alleviation of anemia.

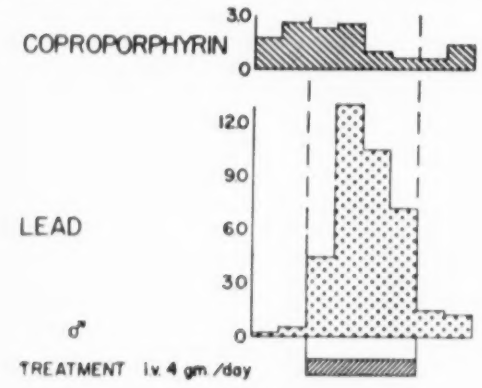

Fig. 6.
Treatment of Pb poisoning with Ca EDTA. Case II.

Fig. 5 gives data on a case of Dr. Elston Belknap.[9] The patient was a 48 year old male junk yard worker who had years of exposure from breathing dust arising from packing empty kraft paper sacks which had contained Pb pigments. He had an intractable anemia for about three years and finally came to Dr. Belknap's attention because of an entry at Columbia Hospital with Pb colic. As Fig. 5 shows, Ca EDTA (4 gm. daily) increased Pb excretion, decreased stipple cells, and alleviated his anemia. Fig. 6 presents a case of Dr. Harriet Hardy,[6] where the treatment resulted in a 30-fold increase in excretion and was associated with a fall in coproporphyrin. Fig. 7, a case of Dr. Brieger of Jefferson Medical College,[2] illustrates the effect of Ca EDTA on Cu urinary excretion in Wilson's disease, namely, approximately a 10-fold increase. The efficiency of B.A.L. given later is also shown. The net effect on the well-being of the individual is not known.

The use of Ca EDTA at this Laboratory for removal of Pu from humans has been limited to two cases. Neither case had a large enough body burden to produce injury, but each excreted sufficient Pu in his urine to serve as a subject for testing the efficacy of the drug in removing the material from the body.

The first case involved a 40 year old female technician who does routine chemical operations with low level Pu solutions. During the course of her work a flask containing $Pu(NO_3)_4$ in 1 M HNO_3 broke and she received a 2-cm. laceration across the base of her left thumb from a jagged piece of contaminated glass. Counts over the surface of her hand varied from 500 to 1000 cpm of alpha contamination. From that time on urine samples were saved for Pu assay, and Fig. 8 shows the results of urine assays. After repeated sampling had ruled out the possibility that counts were coming from her hands or clothing and that Pu had really entered the body as a result of the accident, she was started on a trial of the drug. The wound area was first debrided to eliminate

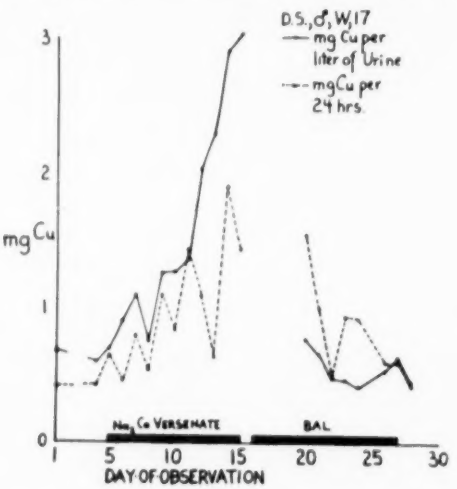

Fig. 7.
Effect of Ca EDTA on Ca excretion in Wilson's disease.

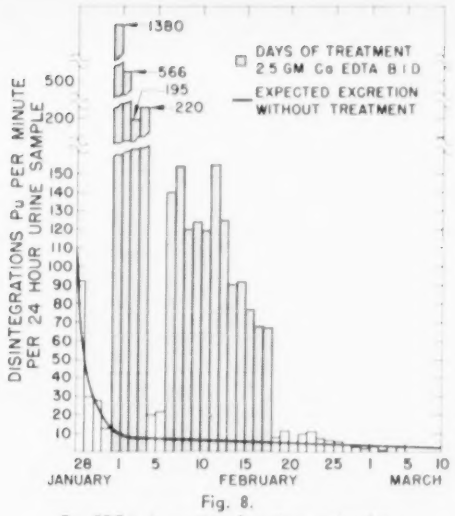

Fig. 8.
Ca EDTA in acute plutonium poisoning.

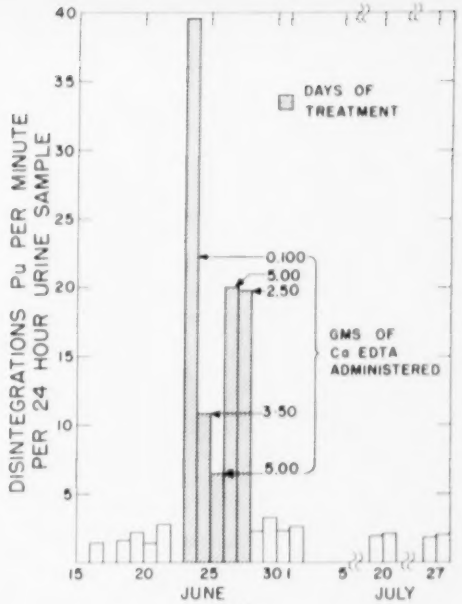

Fig. 9.
Ca EDTA in chronic plutonium poisoning.

the possibility of a dangerously large subcutaneous or intramuscular deposit slowly feeding Pu into the system. Actually, the debrided material yielded only 1700 cpm, a minuscule quantity. She was then given 2.5 gm. Ca EDTA in 250 cc. saline slowly by I.V. drip twice daily at the times indicated in Fig. 8. She was hospitalized the first day but thereafter received her treatment in the first aid room on a come-and-go basis.

As can be seen from Fig. 8, the treatment produced a striking increase in Pu excretion, particularly on the first day, a rise from a pre-treatment level of 12 dpm to over 1300 dpm. The treatment apparently is less effective as time goes on, although it is difficult to judge to what extent because the normal excretion rate (excretion without treatment) as indicated by the continuous curve outlined on the lower portion of the figure is also dropping with time. It is interesting to note the striking initial drop in excretion when the treatment is stopped and then a slower leveling off to the base line. It is estimated from the excretion curve that the patient had a body burden of 25,000 to 30,000 dpm originally, and 20 to 25% of this was removed in the 16 days of treatment. Had the drug been started within a few hours after the accident, when the Pu was still largely in the blood stream or soft tissues, it is likely that the amount removed would have been considerably greater.

Case 2 presents a situation where the Pu was firmly fixed in the body. It involves a male chemist who was 25 years old at the time of his exposure, which was seven years before the trial of the drug. It is presumed that his exposure came about from inhalation of vapor spray during neutralization and oxidation of Pu-containing solutions. It is estimated from his urinary excretion that his body burden is 1.2 μgm. He has never had any signs or symptoms indicative of injury from the Pu. The trial was carried out purely as a test for the efficacy of the drug in chronic Pu poisoning. He was given the material intravenously in saline by slow I.V. drip. The dosage schedule and results are indicated in Fig. 9. Here, as might be expected, the increases in excretion are not nearly as spectacular as in the early-treatment case. There was an over-all average increase of about 10-fold over pre-treatment levels during the five days of trial. It would be interesting to see if the drug continues to be effective when given daily over a prolonged period, since it is apparent from the results that in chronic Pu poisoning it will require months, if not years, of treatment to deplete the body of its Pu store. This is not a particularly desirable situation but it is a preferable alternative to damaging Pu poisoning, just as prolonged insulin injections are preferable to serious diabetes. There have never been any serious cases of chronic Pu poisoning in the United States to our knowledge, and if acute exposures are treated as soon as possible after the accident, the chronic problem may never have to be faced.

In summary, EDTA appears to be of value in the treatment of Pu cases, particularly in the early time period. In view of the innocuousness of small doses of the drug and the importance of early treatment, it is felt that it would be sound practice to give the material as soon as exposure is suspected. No harm is done from giving the drug, and the time gain would be valuable. The diagnosis of exposure from the first 24-hour urine specimen will not be obscured by the procedure.

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"Department of One-Paragraph Reports"

THE following appeared in the *American Industrial Hygiene Association Quarterly* for June, 1955, under the heading, "Department of One-Paragraph Reports": "TO THE EDITOR: I believe many industrial physicians and hygienists will agree that the toxic effects of many new chemicals, as well as some unusual toxic effects of old chemicals, often escape publication in the literature because the observation of such effects occurs as a single isolated instance. The occurrence is unplanned and unwanted, is considered an undesirable accident, and measures are usually taken to be sure it is never repeated. The attending physician has to act on the spur of the moment, and does not have time to make the accurate measurements and observations that would make the case respectably 'scientific.' All he would have to report, if he did report, could be said in one paragraph, and for some reason we are all bashful about putting our names to such a minute opus. The information, shorn of scholarly clothing and bibliographic ornament, and naked in its incompleteness, could still be useful to others. I suggest, therefore, that the *AIHA Quarterly* have a column or page entitled 'Department of One-Paragraph Reports,' to which such material might be sent. A number of industrial physicians have commented favorably on this idea. How about it?—R. W." This was accompanied by an illustrative "one-paragraph" item: "A workman was centrifuging a mixture of benzyl cyanide, sodium chloride, and a small amount of sodium cyanide. He had finished the centrifugal separation and was digging the cake out into an open vessel which contained a small amount of acid water. He became dizzy and faint and decided to go outside for fresh air. He walked with a staggering gait and appeared drunk, although there was no question of his having taken any alcohol. He went for help to another workman in a nearby building, and was unable to stand when he got there. When seen in the plant hospital, he was pale, with a weak, rapid pulse and profuse sweating, and appeared to be in a state of shock. He recovered rather rapidly on being put to bed and kept warm, and he was perfectly normal one hour later. The next day he had a severe headache, became nauseated and vomited violently, but, after staying in bed for two days, was well and able to return to work. A visit to the scene of the accident revealed no symptoms in other men in the same building; the man who completed the job suffered no symptoms. There was a strong odor in the building, somewhat suggestive of bitter almonds, but it was not possible to say whether this came from the benzyl cyanide or hydrogen cyanide gas. It was determined that the sodium chloride-sodium cyanide mixture contained approximately 1% sodium cyanide, and gas bubbles could be seen around the edge of the solid."

The Identification of Accident Proneness

K. T. JOHNSTONE, M.D., Medical Director
Saginaw Plant, Central Foundry Division, General Motors Corporation
Saginaw, Michigan

IT HAS BEEN our belief that the Medical Department in addition to the treatment of injured employees has another equally important function to perform. It has the responsibility of forecasting injuries on the basis of those that have already happened.

To date injury control has been based on three avenues of approach:

1. Mass appeal through signs, posters, and contests.

2. Talks to individuals or groups on a specific safety topic which often had no immediate appeal to the listener.

3. Inspection of machines and correction of defects usually after an injury had occurred.

Something more is needed. During the past five years, in spite of our best efforts, with these methods our injury rate per thousand man hours of labor has remained serene and unshaken.

For about six months we investigated the possibility that certain departments held the key to the problem. We found that the smallest department and one of the larger ones had the highest rates, but there was no pattern developed that we could apply to the prevention of accidents. We then considered the possibility that certain operations might offer the answer. This, too, led up a blind alley, since on even the most dangerous operations there were individuals who rarely reported injuries, and on other seemingly foolproof occupations there were those who succeeded in getting hurt.

We were impressed with the small proportion of total accidents that are caused by machine failure. The vast majority were associated with human malfunction in one way or another. Furthermore, we noted that these injuries were concentrated to a large extent in a relatively small portion of the total plant population. It was obvious, if we were to make any progressive headway in accident prevention, that a much more effective approach was needed to the accident-prone situation.

Much has appeared in the literature about accident-prone workers as a group, but we were unable to find anything dealing with their identification as specific individuals. Because of this a simple method was developed to bring them to light as they came in day by day with their injuries. During the last four or five months of 1954 we talked with 65 of these men individually, in the presence of their immediate foreman, as to how and why their injuries had occurred. They were asked what could or should be done to prevent them. The response was most surprising. Almost without exception they evidenced an honest desire to be of help. As a rule the comments were sound and the suggestions were useful. The following cases represent a cross section of the problems encountered and what we were able to do with one interview per person. These talks lasted about 15 minutes—long enough to develop a cause and reach a tentative solution that would not interfere with production.

CASE NO. 1: Employee J. S. — Clamp up operation.

Injuries reported in the two months prior to the interview: (1) burn left arm; (2) burn left arm; (3) burn left arm; (4) burn right hand; (5) sand in eyes; (6) sand in eyes; (7) cut right thumb; (8) bruise right leg.

Interview revealed that burns were caused by sparks from nearby iron pourer. Employee was wearing short sleeves and poorly fitted goggles.

Solution: Grinder's sleeves were worn over the gauntlet of gloves. Goggles were properly fitted.

In the two months after the interview these injuries were reported: (1) burn of left elbow; (2) abrasion of right index finger.

This man reduced his injuries from eight to two—a reduction of 75%.

CASE NO. 2: Employee H. B. — Core maker.

Injuries reported in the two months previous to the interview: (1) sand in left eye; (2) sand in left eye; (3) sand in left eye; (4) sand in left eye; (5) sand in left eye; (6) sand in left eye.

During the interview the employee reported a leaking sand chamber on an adjacent machine.

Solution: Machine repaired.

Injuries reported in the two months after the interview: (1) sand in the eye.

This man reduced his injuries from six to one — a reduction of 83%.

CASE NO. 3: Employee L. A. — Breaking iron on hot line and sorting into bin.

Injuries in the two months before the interview: (1) sand left eye; (2) sand left eye; (3) sand left eye; (4) sand right eye; (5) sand right eye; (6) bruise forehead; (7) burn of left arm; (8) burn of

Presented at the Seventeenth Annual General Motors Medical Conference, Buffalo, New York, April 25, 1955.

left arm; (9) burn of left arm; (10) burn of left arm; (11) bruise of scalp; (12) blister right finger.

Cause: This employee had very poorly fitted goggles. Used gloves but wore short sleeves. He had to reach across a belt of hot iron to get casting and deposit it in bin. This caused the left arm burns.

Solution: Goggles were fitted properly. It was suggested that he wear a grinder's sleeve on the left arm.

In the two months after the interview these were reported: (1) sand in the right eye; (2) sand in the right eye; (3) burn of the left arm; (4) contusion of lip; (5) blisters of finger of the left hand.

I'm sure that the first three in the five reported after the interview were due to failure to use the suggested procedures consistently. But even disregarding this, he reduced his injuries from 12 to five, or 58%.

CASE NO. 4: Employee E. T. — Hand plate molder.

In the two months before the interview he reported the following injuries: (1) burn of left middle finger; (2) burn of right thumb; (3) contusion of the right wrist; (4) contusion of the left hand; (5) bruise of the left hand; (6) scratch of the neck; (7) F. B. palm of the left hand.

Cause: This individual was an extremely jerky worker. He had poor coordination. Seemed in a perpetual hurry on the job.

Solution: His foreman undertook to coach him in the proper job motion and rhythm.

In the two months after the interview the following injuries were reported: (1) sliver left middle finger; (2) burn of the left hand; (3) abrasion left index finger.

This man reduced his injuries from seven to three, or 57%.

CASE NO. 5: Foreman D. K. — Molding line foreman.

In the two months before the interview: (1) blister right thumb; (2) bruise right index finger; (3) burn of right thumb; (4) blister right palm; (5) sand in left eye; (6) contusion left ear.

The interview revealed that among his duties was the making of minor molding machine adjustments. This he attempted to do without shutting down the machine. His motions were hurried. He could not use gloves. He persisted in the practice and in the two months after the interview reported six injuries: (1) abrasion of right index; (2) burn of right palm; (3) burn of left palm; (4) scratch of left palm; (5) abrasion of right little finger; (6) contusion of right knee.

If injuries are to be reduced, it is, of course, necessary that the causative factor be eliminated after it is found.

CASE NO. 6: Employee H. K. — Millwright.

In the two months before the interview: (1) cut left finger; (2) bruise left middle finger; (3) avulsion of left thumb nail; (4) abrasion of left palm; (5) abrasion of right palm; (6) contusion of left shoulder; (7) sliver on left heel.

Cause: No definite pattern was found. His work was varied and during the interview his attitude was aggressive. No interest was developed in the reduction of injuries.

In the two months after the interview the following list of injuries was reported: (1) abrasion of the left fifth finger; (2) abrasion of the left middle finger; (3) abrasion of the right fifth finger; (4) abrasion of the right middle finger; (5) laceration of the left middle finger; (6) burn of the right shoulder; (7) sand in both eyes.

In this instance the basic difficulty was found in the individual rather than the job. His attitude was indicative of a psychological problem. It cannot be expected that one interview will correct such a situation. However, when these workers are identified, individual study can be given them, which was not possible before.

AS A GROUP the 65 individuals demonstrated a remarkable change in their accident rate after only one interview per man.

TABLE I.
INJURIES PER TWO-MONTHS PERIOD

Individual	Before	After	Percent
65	621	295	52.5
39	No longer considered in the accident-prone group		60.0
15	Showed a marked reduction though still over the average in rate of injury incidence		23.0
54	In all demonstrated immediate benefit from the program		83.0

Several things came to light as by-products in this new program of personal interviews, which were of almost equal importance.

These 65 individuals were distributed evenly among the production and non-production departments alike.

There was, as a rule, a definite pattern of injury in a given worker. A certain type of injury, a burn or laceration, would be characteristic of the man. After interview this common type of injury was removed from the picture and the individual was no longer considered to be in the accident-prone group. The occasional individual not presenting a definite pattern was often the reckless, devil-may-care somewhat aggressive in attitude person, who has been so often associated with accident proneness in other fields such as traffic safety.

When a definite pattern was found on interview, there was usually an unsuspected job factor as the cause of the accident.

This next was particularly surprising. In no case did the individual's foreman realize that the worker was associated with far more than his share of accidents. Many of them later commented that they had no idea that the man had been to the Medical Department on so many occasions. No foreman in cases involving job situations was aware that a safety problem existed on the job.

When it is considered that the immediate foreman did not realize the frequency of injury and also did not realize the presence of an unsolved safety problem on the job, is it any wonder that our previous attempts at injury control had been so futile?

WHEN we embarked on this program we assumed that there were three classes of individuals, the safe, the average, and the unsafe. All we had to do was to talk to the unsafe ones. Nothing seemed simpler. However, when we reviewed

the records we found there was a gradual shading from one into the other. It immediately developed into a question of the number of injuries reported by a given man in a unit period of time—in our case two months.

If a man reports no injuries in two months, in the hazards associated with foundry operations, he surely must be a reasonably safe worker. By the same token, if he reports two dozen injuries in two months he is just as surely an unsafe worker. But supposing he reports 20, 15, 12, 7, 4, 2, or 1 in two months? Certainly somewhere along this descending scale he passes from the unsafe to the safe group. Viewed in this light it meant how many injuries could be reasonably expected in a period of two months. If the number of injuries reported by a given man exceeds this reasonable or expectable limit, it must mean that his performance is enough different from that of other workers to require a definite cause. In an industrial environment this cause must be related either to the man or the job. There are no other possibilities. We have shown this in the cases that were reviewed.

The time of two months was chosen for a specific reason. During the past five years we have been tabulating the number of injuries reported by new employees during the first two months of employment. We have noted that those reporting few or no injuries in this period continued that performance, and we have also noted that those reporting a high number of injuries in the first two months persisted in that pattern as long as they remained with the organization.

Furthermore, we have seen this accident-prone group repeatedly involved in far more than their share of serious injuries that require an excessive amount of time off the job because of prolonged dressings and treatments. We are convinced that each worker develops his own pattern of work and keeps it. We are also convinced that this occurs in a two-months period. For that reason we chose a two-months period as a base in tabulating the performance of workers. It has the additional advantage of being short enough for the man to recall the circumstances of the injuries that are being talked about. This is a necessity if the control program is to be effective.

How do you calculate a *reasonable* number of injuries per man for a two-months period? Common sense tells us that it will be the average number based on plant performance plus a few more to allow for human variation. The performance of the entire plant is used, since that is the record of all of the workers alike. The formula that was used to select these 65 employees may appear somewhat complicated at first glance. Only two items of information are needed: the man hours worked in the plant per year and total number of injuries of all kinds reported per year. The computation can be done annually, in a moment by any engineer friend on his slide rule.

One man in two months of five-day weeks will accumulate 347 man hours. The average number of injuries per man in two months is:

$$\frac{\text{Plant injuries per year}}{\text{Man hours of labor per year}} \times 347$$

$$\text{Range} \quad 2\sqrt{\text{Average number of injuries}}$$

Expectable injuries equals the average plus the range.

Now let us apply the data from the Saginaw Plant for 1954 and see the figures that resulted:

SAGINAW PLANT, 1954

Injuries all types	1954		19,868
Man hours for year	1954		5,094,000
Average no. of injuries per man per two months	$= \frac{19,868}{5,094,000} \times 347$	=	1.35
Range	$= 2 \times \sqrt{1.35}$	=	2.31
Expectable injuries per man per two months		=	3.66
Rounded to the nearest whole number		=	4.

If a man reports four or more injuries in a two-months period he is enough above plant average to be considered accident-prone. The further he exceeds this limit the easier it is to find an operating cause either in him, or his job, or both.

A nurse or clerk can review the records individually as new injuries are posted each day and tell immediately if the allowable number of injuries for a two-month's period has been exceeded. When this is done daily it will continue to bring to light situations that are the breeding ground of accidents. It is as though your records patrol the plant for you each day. Since you interview only the most frequently injured, the vast majority that do their work satisfactorily are not disturbed.

Concern was expressed in the beginning that this procedure would lead to employees failing to report injuries for fear of a "bawling out." Nothing could be further from the truth. In the interview you do not criticize the man, but rather ask for information. Put in this light, we have found the men more than willing to make their contribution.

AT THE Saginaw Plant we have found by using this formula that it is possible to identify specific individuals as being accident-prone. The accuracy of the identification has been proved by the fact that in each case we discovered an operating cause in either the man or the job. This method of analyzing the records in effect reviewed the entire plant, for the men were identified regardless of the department they were in or the job they were doing. Furthermore, in each case where we were able to eliminate the cause the accidents ceased to occur.

We do not believe that an easier or more effective method of injury control has been developed to date.

Psychological Testing —Effect on the Accident Frequency of Bus Operators

HAROLD BRANDALEONE, M.D., Medical Director
EDWARD FLAMM, Research Assistant to the Executive Director
Third Avenue Transit System, New York City

OUR EXPERIENCE in the past few years has led us to believe that psychological factors play an important role in the etiology of accidents. The opportunity for testing this thesis came in 1954 when our company was required to hire a large group of new operators.

Previously we published reports [1,4,5] showing the reduction in accidents in our company resulting from a comprehensive medical program.

Now we are attempting further to improve our accident rate by evaluating the addition of psychological tests to our existing selection program. The purpose of this paper is to evaluate these psychological tests statistically.

Of the 178 new operators employed in 1954, one group acted as a control. They were selected by the older method of selection, while another group acted as an experimental group. The latter were selected by the old method plus the use of three written psychological tests. Since the difference in the two methods of selection resides only in the psychological tests, the difference in accident frequency should show the relative importance of these tests.

Method

CANDIDATES presented themselves for the position of bus operator from diverse sources, such as newspaper advertising, personal contacts, etc. The prior selection program in the company consisted of a personnel investigation, including an interview, followed by the American Transit Association motorability examination.[2,3,4] This motorability examination tests the eye, hand, foot, coordinating speed of response, and sensory-motor coordination. Its function is to test potential ability and capacity to learn, rather than to determine the existence of skills qualifying as a driver.

In addition to the American Transit Association motorability examination, a group of psychophysical tests were performed. The details of these have been reported.[4] They consist of the Keystone telebinocular, depth perception, glare resistance, and lateral vision tests. At this point the old procedure of selection is supplemented by the addition of two written psychological tests that were suggested by Dr. H. Stack, of the Center for Safety Education at New York University,[7,8] and one test suggested and devised by Cleeton and recommended by Kraft of the American Transit Association.[6] These tests were given and evaluated under the supervision of the Personnel Department.

The psychological tests used were the Thurstone Temperament Schedule[7] and the Maslow Security-Insecurity[8] tests, as well as the Standard Examination for Transit Employees recommended by the American Transit Association.[6] It is not our purpose in this communication to discuss the relative merits of these tests. They are the standard procedures that have been tested and utilized and the results reported.

Following these tests the candidate, as previously, was examined by the Medical Department where he completed a detailed history and physical examination, laboratory tests, including urine, serology, chest x-ray, and electrocardiogram.

Results

THE 178 new bus operators hired in 1954 were divided into five categories as outlined in Table I and Chart I.

The criterion of evaluation is the frequency of accidents per man per month by groups (A/M/M). This is computed by dividing the number of accidents by the number of monthly periods. The definition of accidents* is that submitted by our Safety Department.

*This definition of accidents is by the American Transit Association:

1. *Collision Accidents*:
Contact between any part of our vehicles, moving or standing, with any vehicle, object, person, animal or other company vehicle regardless of fault, extent of damage or nature of injury.

2. *Passenger Accidents*:
Any person who comes in contact with our bus while being transported whether within the vehicle or in the act of boarding or alighting, regardless of nature or extent of injury, assault, soiled clothing, sickness, etc.

3. *Preventable Accidents*:
An accident is considered to be *preventable* if there was anything which the operator could have been reasonably expected to anticipate or do, which if anticipated or done, would have prevented the accident.

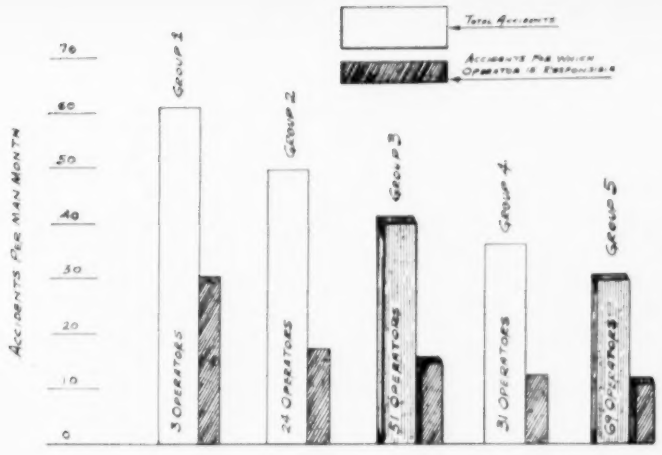

Chart I.
Accident Analysis — Operators Hired in 1954
Total 178

Group 1: No Tests.
Group 2: Failed Motorability Tests, No Psychological Tests Given.
Group 3: Passed Motorability Tests, No Psychological Tests Given.
Group 4: Passed Psychological Tests, No Motorability Tests Given.
Group 5: Passed Both Psychological and Motorability Tests.

Data concerning the length of employment and the number of accidents for each of the 178 operators were obtained from the company's Safety Department.

This information was prepared for IBM analysis to determine the accident frequency per month for each group. These results are shown in Table I and Chart I.

Group 1 contained three candidates who were not required to take any tests. This group had an accident rate of .609 accidents per man, per month, the highest in the study.

Group 2, consisted of 24 candidates who failed the motorability test and did not take the psychological tests. This group had a total accident frequency of .497 A/M/M.

In Group 3, 51 candidates passed the motorability tests and did not take the psychological tests. This group had an accident rate of .412 A/M/M.

Group 4 consisted of 31 candidates who passed the psychological tests and did not take the motorability tests. The accident frequency in this group was .349 A/M/M.

Sixty-nine candidates were in Group 5, who passed both the motorability and psychological tests. The accident frequency in this group was .308 A/M/M, the lowest in the study.

In an effort to eliminate all bias several other criteria were used to evaluate these results. It was decided to study the accident rate in each group using the accidents under operator control (preventable accidents) instead of the total number of accidents.

The study of these preventable accidents (Table I and Chart I) indicate that this ranking conforms exactly to the ranking of the total number of accidents.

A further potential element of bias may have existed in the disproportionate ratio of Preventable to Total Number of Accidents in the group.

It is interesting to note from the figures in Table II that in every category (except Group 1, which only studies three operators) the ratio of preventable to total accidents falls within a range of 35.2% and 38.8%, a close relationship. This indicates that whether we utilize the total number of accidents or study just the preventable accidents, the relationship in each category is similar.

It has been shown" that accident frequency decreases with experience. For this reason it was considered that experience might be a biasing factor in these results. Therefore a study was made of the average length of experience per man in each category to determine if experience influenced our results. These results may be seen in Table III.

The average length of experience in each group is as follows: Group 1, 7.6 months; Group 2, 6.2 months; Group 3, 7.6 months; Group 4, 6.1 months; and Group 5, 4.5 months.

These figures show that experience was not a factor in the number of accidents per man per month in this study.

TABLE I.

Category Number	Number of Candidates	Description	Total Accident Frequency ACC/Man/Month	Accident Frequency ACC/Man/Month Utilizing only Preventable Accidents (Those Under Operator Control)
1	3	No tests	.609	.305
2	24	Failed motorability tests; not given psychological tests	.497	.175
3	51	Passed motorability tests; not given psychological tests	.412	.160
4	31	Passed psychological tests; not given motorability tests	.349	.127
5	69	Passed motorability tests and psychological tests	.308	.117

Comment

THE RESULTS presented indicate that the operators in Group 1 who did not take any tests had the highest accident frequency (.609 A/M/M) while the operators in Group 5 who passed both the motorability and psychological tests had the lowest accident frequency (.308 A/M/M). Unfortunately there were only three operators in Group 1. Since we were anxious to learn the significance of the difference be-

Table II.
Ratio of Total to Preventable Accidents

Group or Category No.	Number of Accidents		Ratio
	Preventable	Total	Preventable Total
1	7	14	50.0%
2	26	74	35.2%
3	62	160	38.8%
4	24	66	36.4%
5	36	95	37.9%

Table III.
Effect of Experience

Category No.	Average Length of Experience—Man
1	7.6 Months
2	6.2 Months
3	7.6 Months
4	6.1 Months
5	4.5 Months

tween Group 3 (those who passed under the previous selection procedure) and Group 5 (those passed under the new selection procedure) we decided to submit these results to statistical analysis.

The results indicated that those operators selected under the new method had a lower accident frequency than those selected under the old. Those who passed the motorability tests had a better accident rate than those who did not take the test. Psychological testing seems to be a finer discriminant than the motorability tests, and both tests are better than either alone.

The statistical evaluation of the results of categories 3 and 5 using standard statistical methods[11] established a critical ratio of 2. This indicated that only in one case in 20 could this difference in group accident rate have occurred by chance. Therefore, comparing these two Groups (3 and 5) in 95 cases out of 100, the new selection method (Group 5) selects a group of operators that have a lower accident rate than a group selected by the old method (Group 3).

The results shown in Table I and Chart I demonstrate that the accidents directly under operator control parallel the results of the total number of accidents in each group. These results plus the results in Table III showing that experience was not a biasing factor in this study, further emphasize the significance of the results originally obtained.

It is therefore suggested that the American Transit Association Motorability tests and psychological tests be used as part of the selection method for bus operators.

We realize that the problem of accident prevention is complex. The psychological factors involved in accidents are difficult to determine or prevent. It is known that there are a few persons in every group who are accident-prone or accident repeaters, but the majority of persons who are considered to be normal may become emotionally disturbed by temporary external stimuli and become involved in an accident. The driver just a few minutes late to his job will rush. If he is very late he may not rush at all.[12] A driver angry because of an argument with a member of his family or his supervisor may well become involved in an accident—a manifestation of his aggression.

The trained physician in a brief interview with a candidate for driving may by experience determine any emotionally unstable person, but it usually takes many hours of study to determine the instability of most persons.

It is our purpose to find some objective method of evaluating these candidates to determine those who would least likely be affected by outside stimuli.

Summary

THE RESULTS of the addition of three psychological tests to our selection program have been presented. The accident rates of bus operators who passed these three tests were better than the control group who did not take the tests.

It is to be emphasized that the psychological factors of accident-proneness are complex. We do not feel that the psychological tests employed in this study necessarily are either the most suitable for driver selection or the most effective in reducing accident rates. However, it is hoped these data will stimulate further investigation that should result in improved methods of selection for motor vehicle operators.

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Traffic Injuries

RICHARD W. ZOLLINGER, M.D.
Surgical Service, Mt. Carmel Hospital
Department of Surgery, Ohio State University College of Medicine
Columbus, Ohio

ACCIDENTS now rank fourth as the most common cause of death. They are exceeded only by heart disease, cancer, and vascular lesions of the central nervous system. In its 1955 preliminary condensed edition of "Accident Facts," the National Safety Council[1] reported 36,300 deaths from motor vehicle accidents in 1954. A total of 1,250,000 individuals were injured. Some decrease in deaths and injuries from auto accidents is shown in 1954 over 1953. Naturally, it is hoped that this decrease is due to the education of the American public, but it may also be a result of the increasing population and the fact that the number of vehicles makes travel much slower.

The reduction of the deaths and the morbidity from traffic accidents is a complex problem. Any progress in dealing with this problem will depend on prevention of accidents rather than on active therapy.

Prophylaxis

PROPHYLACTIC measures include education of the public by safety campaigns, and in first aid measures, more active law enforcement, improved automobile engineering, and emphasis on teaching of trauma to physicians in all degrees of training and practice.

However, in spite of public education and law enforcement there appears small chance of altering man's ways. As Woodward[2] stated in 1949, he saw little likelihood of changing human nature in general or exuberant youth in particular, and it seemed more logical to assume that a further reduction of the rate of injuries and deaths must come from alterations in the designs of automobiles themselves. He suggested certain safety measures on the present-day automobile, such as placing governors on the cars to reduce their top speed to 55 miles an hour, making the frame and body of unit construction, and arranging the windshields so that they would be placed as far forward as possible, and ejectable on impact. He also thought that if there were only one high door per car, the rider's elbows could not protrude, and people could not be thrown through them. Neither could children open them and fall out. Bumpers should be shock-absorbing to reduce impact. Improved brakes, better antiskid properties for tires, glare-proof rear-view mirrors, safety belts, a hydraulic steering apparatus that would move forward with the weight of 100 pounds, crash pads on the dash and on the back of the front seats, elimination of all projecting handles, improved exterior safety lighting such as larger stop lights, and generous use of aluminum paint in marking cars and highways would also help greatly. He suggested elimination of chromium trim and the painting of the top of the car hood a dull black to reduce reflections. He said that the speedometer should be placed conspicuously on the dash, with safe stopping distances marked beneath the various speeds, and that the windshields should be polarized to cut down the glare of oncoming headlights (Fig. 1).

Regardless of how careful and law abiding we are as individuals, we are not safe in our car. We can't foresee our neighbor's reactions under stress, fatigue, changing weather conditions, mechanical faults, and mental worries. Therefore, we must protect ourselves by assuming that a crash may occur at any time.

It is along these lines that the Automotive Crash Injury Research Group at Cornell University Medical College[3] have been working. They have tabulated certain reports, and they state that the right front seat is *not* the suicide seat, and that the passenger there has only a slightly greater chance than the driver of being seriously injured in a crash. They contend that riding in the back seat is three times safer than sitting in the front of the car, and that, in all accidents in

Fig. 1.
Safety With Improved Engineering

Presented at the Sixty-Seventh Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, Chicago, April 13, 1955.

Fig. 2.
Possible Motorist of the Future

which people are injured, two out of three are likely to suffer injury. We are also told that the head is the part of the body most frequently injured, followed in order by the lips, chest, arms, and abdominal areas. They found that necks were seldom broken, but they stated that one out of every 10 injured persons would probably suffer a facial disfigurement. They state that if a passenger is *not* thrown from a car he is most likely to be maimed by the instrument panel or a knob projecting from it. Other danger spots which they enumerate are the glass and the frame of the windshield, followed by the steering components, the door and its parts, the back of the front seat, and the rear view mirror. They state that front end collisions occur in only one accident out of every two.

By August, 1956, this group hope to have over 2,000 accident cases tabulated. They believe that they will have enough data at that time to evaluate the safety hazards in our car design; and it is suggested that the design engineers will probably turn their first attention to door locks that will hold under the impact of modern speed, and that dashboards of all cars will be made of light metal covered by special padding with recessed instrument knobs to protect skulls, jaws, noses, and teeth.

This Cornell Group recommend a safety belt costing approximately $22.00 and anchored to the frame of the car so that it can't be torn loose. They also advise parents that children should ride in the rear seat, as it is three times safer than the front seat. A person should *never* ride in the front seat with a baby on his lap, as the steering wheel, windshield and instrument panel are *all* possible sources of danger. The Group suggest that the steering equipment should resemble a pilot's control wheel and be a concave oval hugging the entire chest. The car seats, which weigh about 50 pounds, would be firmly anchored so that they can't be torn loose and add weight to a hurtling body and thus increase the severity of the maxillafacial injuries (Fig. 2). However, no matter how many prophylatic measures are taken, accidents are bound to occur, and then active therapy is required.

Active Therapy

FIRST AID. Once the injury has occurred, the patient's life may depend on the first aid knowledge of the average citizen present at the scene of the accident, or some county, state, municipal or private emergency organization that usually applies such first aid and transports the injured to a local hospital. Roscoe C. Webb[4] states that several cities have adopted ordinances for regulation of ambulance service. Such ordinances specify the minimum equipment to be carried and the minimum training of personnel in first aid and application of splints, and sets forth penalties for non-compliance. Webb suggests that physicians can insure better transportation for the victims with traumatic injury by obtaining the adoption of such ordinances generally.

Hospital. Once the injury victim has arrived at the hospital, he is under the care of trained medical and nursing personnel. In a report to the Western Surgical Association in Colorado Springs[5] in December, 1954, I analyzed some 9,059 emergency room visits to Mount Carmel Hospital in Columbus, Ohio, in 1953. Of all these, 8.3% were severe enough to require hospitalization. The traffic injuries accounted for 8% of the total of emergency room visits in 1953. However, 75% of these were treated and dismissed, while 25% were severely enough injured to require hospitalization. It was found that 70% of all traffic injuries seen at this hospital were treated between 12:00 noon and 12:00 midnight, and that the hours of dusk and darkness were the most dangerous times to travel. We found that the fewest injuries occurred in the winter season and the greatest number in the fall. The majority of the traffic victims were 30 years of age or younger. We found that the majority of traffic injuries were diagnosed as lacerations, contusions and abrasions, and that 84% of all the patients seen and dismissed from the emergency room had such a diagnosis. The head was the part of the body most frequently injured in such accidents; it was involved in 42% of the total cases. However, laceration was the most common type of head injury. One out of every four traffic accident victims seen in the emergency room required hospitalization. The majority of these—62% of the total admitted to the hospital—were victims of fractures. However, of the total emergency room visits for traffic injuries we found only 7% required a hospital surgical procedure, and only 46% of these were done in the first 12 hours, and these were for fractures.

There were some 30 deaths from motor vehicle accidents which were cared for by the personnel of Mount Carmel Hospital in the year 1953, but of this total, 13 were pronounced dead on arrival at the emergency room and eight died soon after their admission to the emergency room, with only one of these surviving as long as an hour. Nine patients died after hospital admission, two from cerebrovascular accidents which we felt were the primary cause of death. Two individuals sustained severe head injuries with skull fractures, and craniotomy was done on them as a last resort.

One patient with a head injury had a questionable associated abdominal injury and died some 16 hours after admission. One elderly individual never regained consciousness; he had suffered severe compound fractures of both legs. There were three individuals who died of abdominal injuries. The first of these sustained a ruptured jejunum, the second suffered from a ruptured spleen, and the third had a torn ovarian artery with a term pregnancy. We found that although abdominal injuries were infrequent in auto crash victims they were a major cause of death, and that damage to a hollow or solid abdominal viscus should be repaired within a few hours or a fatality will be the result.

We were impressed by the large number of lacerations involving the head area and by the need for good cosmetic care for such wounds. We have been thoroughly impressed by the amount of apprehension associated with traffic accident cases when they arrive at the hospital emergency room attended as they are by worried families, police, perhaps even newsmen. Therefore, the approach to such an injury victim by the medical and nursing personnel must have some organization. Such a plan is outlined in the manual called "Early Care of the Acute Soft Tissue Injuries,"[6] published by the American College of Surgeons in 1954. The main points in this plan are as follows:

1. Stop hemorrhage, splint deformities, and treat shock.

2. Remove all clothing by cutting it away with minimal disturbance of body parts, making them readily accessible for examination and treatment.

3. Obtain and record the victim's history from the most reliable source available. This should include the time and circumstances of the accident occurrence, state of consciousness at and following injury, pre-existing disease or disability, and previous treatment rendered. The examiner must make every effort to establish the two most important points, the time of injury and whether any narcotic has been previously administered.

4. The victim's respirations should be examined by observation, the rate, depth, and rhythm. In every instance, the examiner must be sure that the patient's breathing is not obstructed by the recession of the tongue or the aspiration of blood or vomitus and that the lungs are not deflated by pneumothorax, since these conditions require immediate relief. Always examine a patient's open mouth and use auscultation and percussion on the patient's chest.

5. The determination of the blood pressure, pulse, skin temperature and color will aid in determining the patient's circulatory status.

6. The examination of the general condition of the patient.

7. The examination of the individual parts for specific injury. The individual body parts are generally investigated in order proceeding downward from the head and terminating in the lower extremities.

8. Recording of the physical examination. The pertinent points in the history, general condition and extent of the injuries are recorded and additional diagnostic and therapeutic procedures ordered. In recording the physical examination it is necessary in every instance to note the date, the hour when it was done, and the way in which any treatment was administered during the process.

9. Transportation of the injured for further definitive treatment. The patient is not transported to x-ray or to a hospital bed until the examiner is satisfied that his general condition permits. Any excessive hemorrhage is controlled and all parts requiring immobilization are properly splinted. Once the physical examination has been done and the condition of the patient evaluated there should be a plan of care for such individuals.

Reynolds[7] has stressed an order of priority in such care, and lists it thus:

(1) provide oxygen;
(2) stop hemorrhage;
(3) control shock;
(4) repair perforated viscus;
(5) debride compound wounds;
(6) relieve critical intracranial pressure;
(7) immobilize fractures, and
(8) prevent and treat spinal cord injury.

He states that the intelligent care of automobile injury victims demands the placing of first things first.

Conclusions

IN CONCLUSION, the problem of reducing the number of victims from automobile accidents depends on the over-all education of the public, improved law enforcement, first aid instruction and improved safety engineering of the modern automobile. The active treatment of such victims will include improved first aid by lay people responsible for transporting them, and organized orderly examination and planning for their care in the hospital emergency room, operating room, or hospital room if hospitalization should be required.

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Carbon Monoxide Poisoning

—A DANGER OF FARM AND HOME

J. L. MORGAN, M.D., F.A.C.P.
Emporia, Kansas

THE DAILY newspapers continue to remind us of the importance of carbon monoxide poisoning. During the winter months in Kansas we read of an accidental gas poisoning about every 10 days, and often these gassings involve rather sizable groups such as the diners at a recent church supper. Fatal poisonings are numerically important in Kansas[12] though it is gratifying to see (in Table I) they are apparently decreasing.

TABLE I.
DEATHS IN KANSAS CAUSED BY CARBON MONOXIDE

Year	No.
1950	31
1951	27
1952	28
1953	13
1954	12

Some of the causes of non-industrial carbon monoxide poisoning are poorly vented gas heaters; plugged or leaky chimneys; car exhaust gas; floor furnaces; gas flame refrigerators; trains stopped in tunnels.

Poorly vented gas heaters have accounted for the greatest number of deaths in Kansas in recent years. Typical of the recent domestic poisonings in Kansas was that of a farm couple who died when an unvented cook stove filled their small house with carbon monoxide.[15] The incomplete combustion of illuminating gas in "gas-flame" refrigerators has accounted for a number of deaths in New York City in recent years,[29] though there is no record of such occurrences in Kansas[12,15] in the last five years despite the large number of such refrigerators now in use. The item "trains stopped in tunnel," although obviously not a "common" cause of death, was added to recall the 509 Italians who were killed in one tragic poisoning in 1944 when the freight train on which they had hitched a ride was stalled in a tunnel.[23]

A *few* of the common occupational poisonings[3,4,30] are those of bakers, blast furnace operators, ceramics workers, firemen, mechanics, miners, welders.

Carbon monoxide is produced whenever any carbon-containing material such as coal, wood, gasoline or explosives is partially burned.[23] The gas is odorless except in concentrations over 75% when it smells like garlic.[30] Such high concentrations are so rare as to obviate the preventive value of the odor, but whenever motor exhaust gases can be smelled there is always a significant amount of odorless carbon monoxide present in the mixture.[1]

It has been asked whether cooking and heating gas in homes contains carbon monoxide. Specifically it has been asked what happens when a Kansan attempts suicide by placing his head in an oven and "turns on the gas." The answer is that city dwellers in Kansas are supplied with "natural" gas[25] piped from the gas fields of Oklahoma and Texas.[32] This consists predominantly* of odorless methane with a "warning odor" added in exceedingly small amounts, and there is no carbon monoxide in the mixture as it is supplied in the gas mains. Methane itself is so slightly toxic (depressant)[28] that the only effect even after prolonged inhalation is that of asphyxiation.[25] Typical of the "warning odors" which are added, are the ethyl and amyl mercaptans and the cyclic sulfides such as thiophene.[25] These are added at the rate of three-quarters of a pound per each million cubic feet of natural gas, and none of these is toxic.

The Kansas farmer or trailer owner who has no connection to a gas main uses "bottled gas," properly called "liquified petroleum gas," which is stored in one of the familiar metal tanks standing alongside the farmer's house or trailer. The specific gases used are butane and propane, the latter being the more popular because of its more favorable boiling point.[21] The tanks of butane and propane do not contain carbon monoxide and neither butane nor propane is dangerous when inhaled in the concentrations emitting from the orifice in the farmer's cookstove.[10,21]

In summary, if a Kansan, whether a city dweller using natural gas or an isolated farmer using propane or butane gas, attempts suicide by putting his head in the oven of his cookstove and turning on the gas, he might eventually die of starvation or suffocation, but not of gas poisoning.[21,25] This would indeed be a dreary way to "end it all," and in fact there is no record of such attempts in the Kansas accident statistics in the last 10 years.[12]

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*A typical analysis[32] of Kansas natural gas disclosed: carbon dioxide, 0.52%; oxygen, 0.00%; methane, 90.70%; ethane, 1.12%; residue, 7.66%.

Manufactured gas is not sold for general illumination and heating purposes in Kansas[32] or in most states since natural gas is now being piped to every state in the Union except Vermont and the two Pacific Northwest States.[25] Where manufactured gas is still used it does constitute a hazard since it contains from 5% to 25% carbon monoxide.[25]

Mechanism of Action

PRIMARILY carbon monoxide acts by producing anoxemia. It does this by combining with hemoglobin and rendering it unavailable for combination with oxygen. Unfortunately hemoglobin has a 300 times greater affinity for carbon monoxide than for oxygen.[11] Though this combination with hemoglobin is the predominant mechanism of carbon monoxide poisoning there are other alleged, albeit less significant, actions which are also listed in Table II.

TABLE II.
ACTIONS OF CARBON MONOXIDE

1. Anoxemia: combines with hemoglobin
2. Hinders dissociation of oxy-hemoglobin
3. Hinders removal of carbon *dioxide*
4. Acts directly on pigments and enzymes

In the presence of carboxyhemoglobin the remaining oxyhemoglobin is more stable and hence its oxygen is less available.[23,30] This effect explains the observation that a person with a 50% reduction in hemoglobin ("fifty percent anemia") has more available oxygen than a person who has 50% carboxyhemoglobin.[14]

Oxyhemoglobin which is the natural catalyst in the removal of carbon *dioxide* is decreased as stated above by the preferential combination of hemoglobin with carbon monoxide, and hence with less of the releasing catalyst present, there is less carbon *dioxide* released.[14,30]

Carbon monoxide may directly interfere with the biologic function of certain enzymes and pigments[30] such as the cytochrome-oxidase system.[5]

There are several factors which increase the effect of a given concentration of carbon monoxide. These are prolonged exposure, high atmospheric temperature and humidity,[11] and physical exercise.[7,23,30] The potentiating effect of exercise is well illustrated by the following true story: Several years ago four men carried an injured miner a short distance after an explosion and later all of the four litter bearers were found dead of carbon monoxide poisoning while the injured man they had carried was still living.[23] Supposedly anthracosis, tuberculosis, pregnancy, and hyperthyroidism increase the susceptibility to carbon monoxide poisoning.[30] In studies of couples exposed simultaneously, the women have been *less* affected than the men.[30,14]

Pathology

THE anoxemia which is produced results in generalized changes with the common end organ affected in all of the various tissues being the blood vessels. The capillaries are particularly hard hit by changes following the sequence of dilatation > increased permeability > perivascular edema > hemorrhage.[7,8] Haldane has said "anoxemia not only stops the machine but wrecks the machinery" and this seems true of the anoxemia of carbon monoxide poisoning.[30] Almost every organ has been described as being damaged, and to attempt to remember each of the changes reported is to lose oneself in a maze of detail. The organs most commonly affected are the brain; heart (conduction fibers, coronary vessels); lungs; skin.

The brain and the heart sustain the greatest damage.[7]

Reversible cerebral edema accounts for the common symptoms of headache and vertigo.[26] The basal ganglia, particularly the corpus striatum[7,11] and the globus pallidus[5,11] are occasionally involved and their impairment accounts for the sequellae of Parkinsonism.[11] A generalized hemorrhagic encephalitis may occur following massive gassing.[7]

The cardiac damage usually involves the conduction pathways and the coronary vessels. Coronary thrombosis has often been reported, from damage of the endothelial lining.[7,30]

Pneumonia is seen in about 10% of those who have been unconscious.[14]

Skin changes such as blisters and hemorrhages usually indicate severe poisoning.[4]

There are clinical findings in carbon monoxide poisoning which are difficult to explain pathologically, for instance, the rather common findings of hyperglycemia, and glycosuria.

Diagnosis

THE surroundings in which the patient is found often suggest the diagnosis. There isn't much need or time for considering the differential diagnosis when several members of a family are found unconscious in a tightly closed house which is obviously overheated with a poorly vented stove. The symptoms, signs, and laboratory findings usually will piece out the picture with clarity.

Symptoms

THE symptoms of carbon monoxide poisoning which have been reported are as multitudinous as are the pathological changes which precede them. Some of the common symptoms [14,23] are headache, confusion, postural vertigo, blurred vision, thick speech, nausea and vomiting, loss of consciousness.

Headache is perhaps the most common symptom, and this is variable in its location, character, and duration.[23] There may be "tightness" across the forehead or "throbbing" in the temples.[23]

Loss of consciousness may occur without warning in high concentrations or it may occur after a prelude of headache and confusion.[23]

Physical Signs

THERE are no consistent physical findings. The familiar cherry red color of the carbon monoxide hemoglobin is often seen in the skin and mucous membranes, though cyanosis is found almost as often.[20,31] Slow and moderate poisoning may

cause tachycardia, whereas high concentrations cause a bradycardia.[30] The pupils, blood pressure, and tendon reflexes are so variable as to be of no help in establishing a diagnosis.[20] An excellent study has recently been made in which the physical findings making for a fatal outcome have been singled out.[20] These, as listed, may be called "foreboding signs" and are worth noting: mental relapse after apparent recovery; prolonged coma; body temperature over 102°; respirations over 30 per minute; urinary or fecal incontinence; skin blisters.

The development of confusion after the patient has seemingly recovered from the acute poisoning, so-called "psuedo-recovery" is an ominous sign. One old rule of thumb regarding coma is that if the patient recovers consciousness within one hour after removal from the toxic atmosphere, the outlook is favorable.[30]

Laboratory Tests

SOME of the more common laboratory tests which are altered in carbon monoxide poisoning are listed in Table III.

TABLE III.
CHANGES IN "ROUTINE" TESTS

Blood:	
(a)	Red cell count increased.
(b)	White cell count increased.
(c)	Hyperglycemia.
Urine:	
(a)	Albuminuria.
(b)	Glycosuria.
Electrocardiogram:	
(a)	Arrhythmias.
(b)	T wave inversions.
(c)	Conduction defects.
(d)	S-T segment changes.

The red blood cells are increased in part as a compensating polycythemia.[30] When the white blood count is over 18,000 it is good evidence that the poisoning has been severe.[20]

The albuminuria and glycosuria are transitory.[14]

The arrhythmias noted on the electrocardiogram are most commonly ventricular premature contractions, auricular fibrillation and nodal rhythm.[20] The P-R interval is often prolonged evidencing a defect in the conducting mechanism of the heart.[30]

An outline of the specific tests for carbon monoxide in the blood is seen in Table IV.

TABLE IV.
SPECIFIC TESTS FOR CARBON MONOXIDE

Qualitative tests:	
(a)	Alkali test. Two drops of blood are mixed in a porcelain plate with two drops of 25% sodium hydroxide. A reddish color remains in the blood containing carboxyhemoglobin, whereas normal blood turns a brownish color.
(b)	Welzel's test. Employs distilled water and hydrogen sulfide water and is accurate after embalming.
Quantitative tests:	
(a)	Colorimetric.
(b)	Optical.
(c)	Titration.

The alkali test is easy to perform and is used in the laboratories of many of the smaller hospitals in Kansas [19] and also at the Hospital of the University of Kansas.[18]

It is occasionally worth knowing for medicolegal reasons that such a test as the Welzel test is accurate after embalming.

The colorimetric tests compare the red color of the blood containing carboxyhemoglobin to carmine or some other prepared set of standards.[23] One of these colorimetric tests, the test of Sayers, Yant, and Jones is used by the Kansas State Board of Health.[13]

The optical methods employ the spectroscope or the spectrophotometer to detect the specific absorption bands of the carboxyhemoglobin in the spectrum.[30] These are accurate and speedy methods, but the apparatus is bulky and expensive.[23]

Titration of the carbon monoxide gas incorporated in the blood is accomplished by liberating the carbon monoxide and the oxygen, absorbing the oxygen and then measuring the remaining carbon monoxide directly in the van Slyke apparatus.[23]

The time interval between exposure and testing frequently makes the evaluation of the quantitative tests difficult.[20] In fact, the physician is often so busy keeping the patient alive and quieting the relatives and the curious bystanders that he finds little time to take any sort of specimen for analysis. About one half of the carbon monoxide is breathed out of the body the first hour after removal from exposure.[14] Blood taken for later qualitative or quantitative analysis should be prevented from clotting by the use of a citrate solution rather than oxalate since oxalate causes an appreciable change from carbon monoxide to carbon *dioxide* on standing.[17]

Differential Diagnosis

THE MOST common mistaken diagnoses[2,22] made on patients poisoned by carbon monoxide are alcoholism, food poisoning, epilepsy, brain tumor, diabetic coma, schizophrenia.

Any of these conditions can produce coma or stupor similar to that seen following carbon monoxide gassing. Of course, a drunken celebrator may fall asleep in his car with the motor running and be doubly poisoned, so to speak.

Treatment

THE basic treatment of carbon monoxide poisoning is straightforward: (1) Remove the patient from the gas. (2) Artificial respiration. (3) Administer 5% to 10% carbon dioxide in oxygen by nasal catheter or mask. (4) There are no specific drugs.

From the rescuer's standpoint it is important to know that the ordinary army gas mask will not protect against carbon monoxide.[23] There is a special mask containing a mixture of chemicals collectively labeled HOPCALITE which protects by oxidizing carbon monoxide to carbon dioxide.[30] This mask unfortunately becomes ineffective after about 30 minutes' use.

The rescuers should exert themselves as little as possible while in the gassy chamber—remem-

ber the story of the four men who died carrying the stretcher whereas their passenger lived.[23]

Artificial respiration is, of course, indicated if the patient is too stuporous to breathe.

Supposedly 5% to 10% of carbon dioxide in oxygen increases the depth and rate of respiration and hence aids in removing the carbon monoxide,[4,14,30] though the actual benefit of the carbon dioxide has been challenged.[23,24]

Although there are no specific drugs, caffeine is often used as a respiratory stimulant.[14]

Other treatments than those enumerated have been advocated. A few of these are worth noting and the rest will be mentioned for the sake of completeness. Procaine intravenously has been used in an attempt to improve cerebral circulation,[2,9] and spinal puncture has been thought by some to alleviate the cerebral symptoms of poisoning.[30] Venesection alone or followed by transfusion has been mentioned in the literature,[16] though venesection alone has been felt to be ineffective.[14]

X-ray treatment and ultraviolet light therapy have been tried without much success.[30] Exercise was once advocated, but is now known to be strictly contraindicated.[30] Many drugs have been tried and discarded. These include emetics, digitalis, morphine sulfate, atropine, strychnine, methylene blue, hydrogen peroxide combined with ferric chloride (intravenously), and colloidal sulfur (intravenously).[30]

Sequelae

PERMANENT after effects are extremely rare compared to the total number of cases seen. Only about one in 500 of those acutely poisoned who survive the initial episode have permanent damage.[26] The changes most frequently seen are psychoses and Parkinsonism.[14] The psychoses are characterized by confusion, loss of judgment, bewilderment and amnesia.[14,26] Many of the initially alarming psychoses clear up in about three months.[26] The neurological findings of Parkinsonism may immediately follow a period of unconsciousness or may first appear after an asymptomatic period of one to three weeks.[11] The degree of permanent residual damage is most closely correlated with the duration of the unconsciousness.[5]

"Chronic" Poisoning

THE diagnosis of chronic carbon monoxide poisoning is not universally accepted as a valid one. Since carbon monoxide is not stored in the body, but rather is excreted in a matter of hours[14] it is difficult to see how so-called "safe" doses can cause damage even if they are repeated many times. The classic rebuttal to those who advocate chronic poisoning as an entity is the study of 156 policemen who worked in the Holland tunnel in New York City for 13 years.[27] These men inhaled appreciable amounts of gas daily yet had no sign of any illness on careful examination. It is true that a series of repeated *toxic* exposures can cause a picture of damage which represents an accumulation of separate insults[6,14] and it may be that concentrations of carbon monoxide previously thought to be harmless are actually dangerous—and this latter reasoning may be the clue to the solution of the controversy over so-called chronic poisoning.

Summary

CARBON monoxide poisoning is a problem in Kansas as elsewhere. The gas when inhaled produces anoxemia by combining with hemoglobin. Pathologically the small blood vessels are the main target organs of the anoxemia and these vessel changes are so widespread that the clinical picture is extraordinarily variable. The diagnosis is usually suggested by the history or the surroundings in which the patient is found. There are simple qualitative blood tests which may help to detect carboxyhemoglobin. Treatment is based on ventilating the patient's lungs with fresh air or a carbon dioxide-oxygen mixture. Permanent sequellae such as psychoses and Parkinsonism do occur but they are extremely rare. Chronic carbon monoxide poisoning is a debatable entity.

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The Three Principles of Rehabilitation

The first principle of rehabilitation is *patient-centered treatment*. This does not excuse us from adequate diagnosis and proper care of existing illness or injury, but rather that we approach the clinical problem with an appreciation of what the disability means to the patient. The second principle of rehabilitation is that *restoration begins when medical care is started*. The responsible physician brings with him a sense of security and imbues the conscious patient with a feeling that the difficulties will be met successfully. Just as there is an organized and purposeful method in making the diagnosis, there is also a broader but just as purposeful over-all plan of treatment which will eventuate in the patient's return to productive employment. For example, if an injury be such as to necessitate the amputation of an arm or leg, the earlier the patient can be informed of the fact that he will be able to wear a functional prosthetic replacement, the better are his prospects of successful rehabilitation. Much needless worry may be obviated by the simple expedient of giving the patient the benefit of good medical perspective. The third principle of rehabilitation is *intelligent use of teamwork*. Rapid advancements in the fields of medical science have made it increasingly difficult, if not impossible, for one physician to possess and practice all the requisite skills. For many years we have used the team approach in surgery. Modern medical clinics encompass a group of men who are highly skilled in different phases of medical care. It is not surprising, therefore, that rehabilitation also demands teamwork if it is to be effective.

—From a presentation on "Principles of Rehabilitation," by Ben L. Boynton, M.D., at the Sixty-Seventh Annual Meeting of the American Association of Railway Surgeons, Chicago, April 14, 1955.

The Physician and Dental and Jaw Injuries

LEONARD S. MORVAY, D.D.S., F.I.C.A.
Newark, New Jersey

ONE significant example of the increasing degree of cooperation and understanding between physicians and dentists is the publication, in many dental periodicals, of articles on medical subjects with special reference to dental practice.

Some of the professional dental journals regularly allot space, in a "medical-dental" department, to articles of this type. This is a recognition of the necessity for continued liaison between the members of both professions.

It may seem presumptuous for a dentist to attempt to instruct physicians in the management of industrial dental and jaw injuries, especially since the incidence of this type of industrial accident is small compared with other types which make up the bulk of an industrial medical practice. Nevertheless a steadily increasing number of industries, and the physicians responsible for industrial medical programs, are becoming aware of the practical value of a well organized dental program as part of the total industrial health picture.

The average industrial physician can rarely make even a reasonably accurate determination of the percentage of jaw disability following the completed treatment for a jaw fracture. We can not expect him to do so; he has had little or no training in this phase of dentistry on which to base judgments about permanent residual disability.

Occlusion, one of the most complex and controversial subjects in the field of present-day dentistry, is receiving extensive interest and discussion from thoroughly trained and highly specialized periodontists, orthodontists and prosthodontists. Even these men, who have devoted years of study to the problem, cannot reach universal agreement on the intricacies of dental articulation.

Understandably, the dentist, with his special training, is better equipped to render dental first aid than is the physician, but, if a dentist is not immediately available, the physician should be familiar with emergency procedures for industrial dental accidents. He should be prepared to render proper treatment until a dentist can be called to the case.

Presented at a meeting of the Occupational Medicine and Hygiene Section of the Academy of Medicine of New Jersey, Newark, December 7, 1954.

Fractures of the Jaw

BASIC emergency treatment for jaw fractures is application of a four-tail bandage. If there is any possibility of a skull fracture, minimum tension should be applied when the bandage is placed. This type of drsesing will keep the patient with a possible jaw fracture comfortable, at least, until the industrial dentist takes over.

The bandage should be of light flannel material if this is available; if not, an ordinary bandage, three and a half inches wide and three and a half feet long, is satisfactory. Cut the bandage into even lengthwise parts, except for seven inches left uncut in the middle. Tie the superior tails posteriorly and inferiorly on the back of the head, and tie the inferior tails superiorly on the back of the head. Then fasten both tails together at the top of the head. Preoperative jaw fracture treatment is similar to that employed for fractures of the extremities and includes periodic ice packing, sedation, and the administration of antibiotics.

Only the dentist should be permitted to provide definitive treatment for jaw fractures and complicated, extensive loss of teeth; also, he should be brought into the picture as soon as it is possible. The industrial physician should insist that a dentist be called in for all fractures of the jaw, even if the case at first appears uncomplicated. There is no reason why the physician should expect himself to be an expert on dental articulation, any more than he expects the dentist to be an expert on joint articulation. When a problem of occlusion arises, both should be on the maxillo-facial team. One can well imagine the disaster that would follow an attempt on the part of a dentist to put a limb in traction; so, too, a jaw fracture set by a physician will often require refracture because of the physician's unfamiliarity with dental articulation.

Not long ago the author was called into consultation by a physician who attempted to set what he thought was a fractured mandible. The patient happened to have a congenital marked protusion of the lower jaw ("bull-dog bite") and the physician, observing a bite which was not normal, concluded that the jaw was fractured.

Severe injuries to the maxillo-facial structure are not uncommonly accompanied by acute changes in the general physical condition of the patient, and the dentist will be aware of his re-

sponsibility to call in a physician for general medical management. The physician called into consultation by the industrial dentist will be requested to make periodic general examinations of the injured employee until the case has been discharged by the dentist.

Trauma to the Teeth

WHEN trauma to the teeth and surrounding tissues occurs, every effort should be made to preserve the involved teeth even though they may be so extremely mobile that the dental forceps—or even the fingers—appear to be the only treatment indicated.

Natural teeth which discolor following reinsertion in the original bone voids can be readily jacketed; they may serve the patient, aesthetically and functionally, for years.

An ill-considered and hasty diagnosis, followed by unnecessary extraction of traumatized teeth, forces the employing industry to pay four weeks of permanent disability benefits at $30.00 a week in this state for each tooth sacrificed, and further obliges carriers to provide substitutions, in the form of prosthetic restorations (an average of about $200.00 total cost), for each condemned tooth. Most important, of course, is the fact that the employee is needlessly deprived of permanent teeth and if these are not replaced, he often becomes a "dental cripple."

The immobilization of loose teeth by interdental wiring, followed, if necessary, by the application of a splint, stabilizes teeth within a week or 10 days after the accident even though the teeth may have been extremely loose immediately following the trauma. Even completely dislodged teeth, when recovered, immediately sterilized and replaced in their sockets, become solidly attached to the alveolus in many cases. With modern endodontia treatment these teeth, once thought to be lost beyond all hope of recovery, will serve their owners long and well if they are replaced in the alveolus void within 12 hours. The sooner they are replaced, the more favorable the prognosis. The natural process of repair will accomplish seeming miracles if given an opportunity to do so.

Adequate first aid to teeth loosened by industrial trauma must be given as soon as possible after the injury. The employee must not be permitted to test the looseness of involved teeth by digital pressure, since this retards the natural reparative process which begins immediately after injury. No food which would put a strain upon the involved tooth is to be masticated; only soft foods are permitted.

If the teeth are very loose, heat beeswax or ordinary candle wax and place around the crowns of the involved teeth both labially and lingually. The wax, molded gently but firmly by the fingers, will serve very well as a temporary splint. Permit the wax to harden in place, but have the patient bring upper and lower teeth together in tight occlusion while the wax is setting, to accommodate the bite after the wax has hardened.

Summary

THE general and particular principles of responsibility governing industrial dental practice are outlined, with the respective duties of dentist and physician defined. Special attention is directed to first aid measures which the physician can perform when an industrial accident has caused jaw fracture or seriously loosened teeth.

(30 Central Avenue.)

The Vacation Athlete

I'VE WORKED around all kinds of vacation places. The more I see of the woods, the water, and hunting and fishing equipment, the more respect I have for these things. I'm a good swimmer, but I've learned to take all the precautions I can when I'm in a boat. I can hike 15 or 20 miles in a day; but, when I do, I don't try to run all the way. I know that a fishook is a dangerous weapon, and I don't go fly-fishing in a boat with two or three other fellas when there's a fairly strong wind. But it's a funny thing; every year I take out parties of people who just ask for a broken leg, a fishook in the ear, sun stroke, or a heart attack. They don't do these things on their job; why haven't they got sense enough on vacation to use their heads the way they do back home?"

—Editor, *New Hampshire Health News*, quoting a guide, in *What's New in Industrial Nursing*, June, 1955.

The Carcinogenic Properties of Cutting Oils

WILLIAM B. TAYLOR, M.D., and RICHARD E. DIGGS, M.D.
Ann Arbor, Michigan

THERE ARE many reports in the literature describing the action of cutting oils in producing dermatitis in machine operators. Little, however, has been written concerning the carcinogenicity of cutting oils. This is a report of two cases of skin cancer following 25 to 35 years of exposure to cutting oils.

The Literature

PERHAPS the best reports are those of Cruickshank and Squire[1] who made a study of 138 workers exposed to cutting oils in three factories. They found that 80% had oil folliculitis, 33% had hyperkeratoses on their arms, and one had a scrotal carcinoma. There was a direct correlation between the incidence of these hyperkeratoses and the length of time the men had been exposed to cutting oils. Those exposed only a few years had the lowest incidence, while for those exposed more than 15 years the incidence was over 50%. They point out that the widespread incidence of oil folliculitis in these workers is due to the fact that heavy contamination with oil on the forearms is the rule in automatic screw machine shops. The worker with scrotal carcinoma gave a history of exposure to cutting oils for 21 years in an automatic machine shop.

In another study within the same report, Cruickshank and Squire reviewed the case records of all the patients treated for scrotal cancer at the United Birmingham Hospitals during the 10-year period 1939 to 1948. They found that there were 34 cases of scrotal cancer, and, of these, 12 patients gave a history of exposure to oil. Six of the 12 worked with machine tools and had been exposed to cutting oils for many years. Cruickshank and Squire concluded that skin cancer is occurring in industry mainly in those jobs involving heavy exposure to cutting oils but also occasionally in other oily jobs. They believe the reason that so few cases have been found thus far is that automatic screw machines have been in use only about 25 to 35 years and initially only a few workers have been involved, and thus more cases of skin cancer developing from exposure to cutting oils can be expected.

These investigators took a sample of cutting oil from one of the three factories and applied it topically to rabbit skin. This oil was found to be capable of producing benign tumors on some of these rabbits after 24 weeks' exposure.

Cruickshank and Gourevitch[2] made an investigation of patients treated for skin cancer of the hand and forearm at the United Birmingham Hospitals during the 10-year period 1941-1950. They observed that a significantly large proportion of cases occurred among metal workers. Exposure to oil is suggested as the probable cause.

Schwartz[3] reports that some of the mineral oils have keratogenic properties and cause the appearance of small flat brownish papillomas on the hands, arms, and other parts touched by the oil or oil soaked clothing. He states that about 10% of all workers in oils and greases have these growths. He further notes that cutting oils consist principally of mineral oils.

A major petroleum company's industrial hygiene department[4] in this country has undertaken experimental research on mice with cutting oils. Already they have found that benign tumors, warts and papillomas were formed on continued application of the oil, and an occasional skin cancer developed.

Extensive investigation,[5] under the sponsorship of the petroleum industry in the United States and England, has conclusively shown that an appreciable number of the high boiling point oils, especially those obtained in catalytic cracking operations, possess carcinogenic properties for the skin of mice. However, oils have been in production in such equipment only about 10 years. So far, few cases of skin cancer have developed in humans but increased incidence can be expected as the length of the exposures increases. A report is in prospect on the experimental demonstration of carcinogenic properties of cutting oils in the forthcoming Proceedings of the First Conference of the National Cancer Institute of Canada.[6]

Case Reports

IN SUPPORT of this concept, two cases of skin cancer appearing on the arms and hands of workers exposed to cutting oils over a long period here are presented.

Case of T.E.: age 53, white male, employed in the machine tool industry since the age of 17, with much of this time spent on automatic screw

From the Institute of Industrial Health, Department of Dermatology, and School of Public Health, University of Michigan, Ann Arbor.

Fig. 1.
T.E. Keratoses, atrophy, hyperpigmentation of forearms and hands. The scars are from x-ray and fulguration and curettage of squamous cell carcinomas.

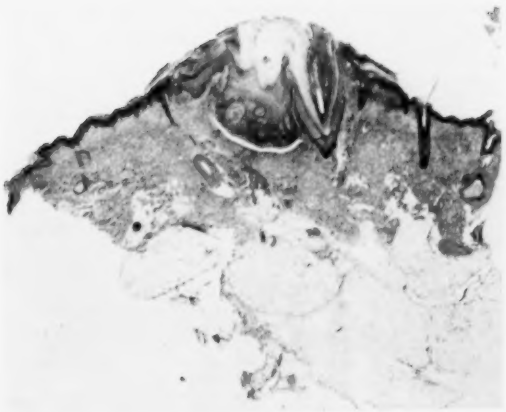
machines. At work his hands and forearms were covered with cutting oil and his trouser legs and tops of his socks often were grossly contaminated with this oil. For the past 12 years he has been in a supervisory capacity in which he has not been much exposed to oil. About 12 years ago, he began noticing scaling and hyperkeratotic lesions on his arms. Early in his work he was troubled considerably by oil folliculitis.

Physical examination disclosed a well developed white male with light brown hair, brown eyes and medium complexion. His face appeared somewhat ruddy and the skin on the helix of the ear revealed several hyperkeratotic lesions, though his face was free of such lesions. The striking features of this man's skin disease were manifested on his arms and hands from the base of the fingers to the mid-upper arm. The skin in this area was covered with hyperpigmented patches with innumerable hyperkeratotic lesions, some of which were on an erythematous base. These lesions varied in size from 2-3 mm. to 2 cm. in diameter. Clinically these were typical senile keratoses. There were several scars on the dorsum of the hands and lower forearms which were the sites of keratoses that had become malignant and had been treated by x-ray or by surgical excision. Many smaller pigmented scars represented similar lesions that earlier had been treated by fulguration and curettage. Three of these former lesions proved to be squamous cell carcinoma by microscopic examination. No keratin cysts, comedones or acneform lesions were present. Areas of skin on his hands and forearms not affected with the keratoses had an atrophic appearance. No symptoms associated themselves with these lesions except for some dryness and tenderness of the hyperkeratotic areas when irritated. He also had hyperkeratotic lesions on his ankles.

Case of D.W.: age 57, white male, has worked in cutting oils since 1918 on automatic screw machines. Since 1948 he has operated his own machine shop. He furnished a history of constantly being covered with cutting oil while at work and also of saturation of trouser cuffs and shoes with the oil. During the past three years he has noticed the development of wart-like lesions on the arms and backs of his hands. Prior to this he seldom had any skin lesions except for oil folliculitis. In March, 1954, this man was seen in the dermatology outpatient department of the University of Michigan Hospital. He was a dark-haired and dark-complexioned individual. He had no hyperkeratotic lesions on his face. The dorsum of his hands and forearms was covered with numerous hyperkeratotic lesions which clinically were senile keratoses. These wart-like keratotic lesions also were present on his ankles. One lesion on the dorsum of the hand was excised and pathological examination revealed a squamous cell carcinoma. A considerable area of the adjacent skin was so extensively affected by hyperkeratotic lesions that excision and skin grafting were required. Microscopic examination revealed another early squamous cell carcinoma in this tissue.

Comment

THESE two cases are similar: both having been exposed to cutting oils from 25 to 35 years;



D.W. Early squamous cell carcinoma arising from a keratosis on dorsum of hand. Higher magnification shows malignant dyskeratosis, numerous mitotic figures, invasion of dermis by squamous cells.

D.W. Similar lesion from dorsum of hand, showing same changes. Diagnosis, squamous cell carcinoma.

Fig. 2.

both working on automatic screw machines; both developing oil folliculitis early in their life work and many years later developing hyperkeratotic lesions on their arms, hands, ankles, and feet, and squamous cell carcinoma of arms and hands.

Our first impression was that sunlight was an important factor in producing keratoses and carcinoma in our patients, just as it is in people not exposed to oil. However, the presence of keratoses on the ankles in our two patients tends to minimize the significance of light as an etiological factor. Both patients were quite positive that their trouser cuffs and tops of their socks were commonly saturated with oil, which seems to give supporting evidence to the theory that long continued exposure to cutting oils can cause hyperkeratoses without excessive exposure to sunlight. The absence of senile keratoses on the face in both patients and limitation of the lesions on the arms and hands to areas exposed to oil appears to be significant.

It is reasonable to assume that if cutting oils

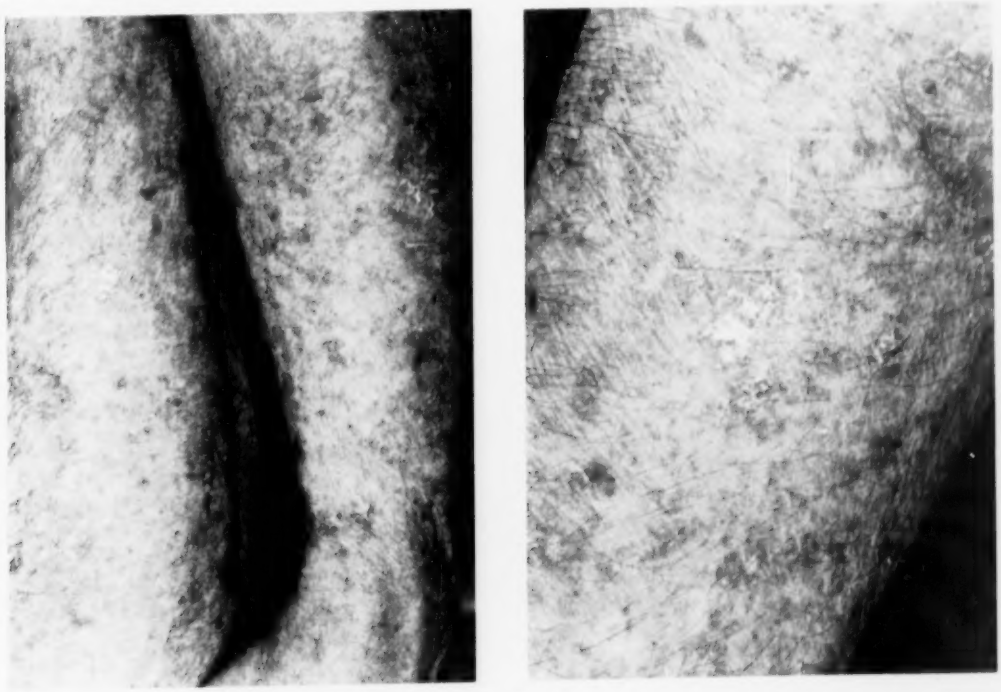


Fig. 3.

D. W. Hyperkeratoses, hyperpigmentation, atrophy of forearms. So-called "shagreen skin."

can stimulate the development of hyperkeratoses, they can also produce skin cancer if given sufficient time. Also, there are reported a number of cases of skin cancer occurring in the petroleum industry and it is reasonable to assume that it can occur in men who are exposed to cutting oils. In the petroleum industry the oils that are carcinogenic are the high boiling catalytically cracked hydrocarbons.

Cutting oils vary a great deal in consistency but most of them contain mineral oils and some appear to be carcinogenic.

Summary

PUBLISHED evidence of cutting oils as an etiological factor in hyperkeratoses and skin cancer is briefly reviewed.

Two cases of skin cancer resulting from long exposure to cutting oils are presented.

Comment is made upon the evidence for the theory that cutting oils can cause skin cancer.

(University Hospital.)

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The Periodic Examination—Who? And Where?

IF PERIODIC examinations are worth-while they should be offered to all employees—from the watchman at the gate to the chairman of the board. A fair start has been made but there is still a long way to go in this field. For many years some companies have offered to all or to special groups of employees periodic examinations in their respective plant Medical Departments, but recently they have set up special comprehensive types of examinations for executives. It might be argued that the investment in the executive and his value to the company justifies the more comprehensive type of examination, the nature of which is such that it becomes necessary to send him to some clinic for the examination. Some persons, however challenge the need for the two types of examinations. Furthermore, by certain groups going outside for examinations the confidence of the employees in the company's medical service might be shaken. This situation merits further study. Industrial Medical Departments, clinics, and private practitioners are presently participating in giving such examinations. In the final analysis no one plan may be found to be entirely suitable and a combination of plans may be necessary. In the meantime, the important thing is to have the employee or the executive examined.

—From "Re-evaluating the Physical Examination in Industry," by M. N. NEWQUIST, M.D., Medical Director, The Texas Company, at the Nineteenth Annual Meeting, Industrial Hygiene Foundation, November 17-18, 1954.

Technique of Medical Survey for Proposed Foreign Operations

ROBERT J. BIGGAR, M.D., Chief Medical Officer
California, Texas Oil Company, Limited

MODERN industry is exerting itself increasingly today to develop the natural resources lying dormant throughout much of the world. For the first time, many remote areas are seeing signs of progress in the utilization of their physical resources and latent manpower. With these stirring developments has come a challenge to industrial medicine, for frequently development would be impossible without a well-organized medical program.

In some isolated areas, health conditions are so hazardous that nobody will go to work without being assured of adequate medical care; in other areas, health and sanitation levels may not be high enough to safeguard an influx of workers. Proper medical planning does more than overcome these immediate problems; it usually so raises the general standard of health among local inhabitants that the region begins to enjoy considerable economic gains.

It has been my privilege to go into some of the more remote sections of the world to make surveys and do the forward medical planning for possible future operations. Over a period of years, by trial and error, a more or less definite outline for this type of planning has evolved. It is not perfect; new situations frequently arise which require new thinking and a changing approach. On the whole, however, the plan has proved to be inclusive and readily workable for the industrial surgeon called upon to make such a study.

Basically, the plan breaks down into the four-step method used by doctors for generations. Business has borrowed this method from the physicians and spends considerable energy and money getting it into use by its managements and employees.

These four steps, as utilized by business, with medical equivalents are:

1. *Get all the facts.*

Corresponds to obtaining medical history and symptoms, giving physical examination and all indicated special diagnostic tests.

2. *Weigh and decide.*

Doctors study the facts and make diagnosis.

3. *Take action.*

Medicine, surgery, or other course of treatment prescribed and undertaken.

4. *Check results.*

Follow-through to see how patient responds; if unsatisfactory more facts may be necessary, perhaps new diagnosis and new treatment.

Here is the same four-step method amplified to cover all the essential details in planning and setting up a satisfactory medical organization of the type under discussion:

GET ALL THE FACTS:

Before actually going to the proposed location of the new project, a number of factors should be determined. First, will the proposed operation be confined to a small area or will it spread out over a large district? Will manufacturing, exploration or some other type of work predominate? When will construction start and what is its approximate finishing time? When will the operating schedule start? Are enlargements contemplated at a later date?

Answers to these questions will provide a general over-all view of the project under consideration. To fill out this preliminary picture, information about personnel must be obtained along the following lines:

What is the anticipated number of expatriate personnel during construction? How many will be company employees and how many will work for contractors? How many nationals will be employed by the company and by contractors at this period?

When actual operations start, what will be the permanent strength of expatriate personnel and of local personnel? What is the planned strength in each category for future operations?

After these general facts about the size and type of the project and its personnel have been determined, the actual survey at the proposed site can be undertaken with a clearer view of the problems that will be encountered on the medical level.

Usually the Medical Department will have little to say about the actual selection of the site; often it is the only location available because of geographical and economic reasons. But within the site, medical opinion may be sought as to the most desirable locations for various installations such as hospitals, office buildings, perhaps the main entrance.

Particular attention should be paid to the areas adjoining the site to determine the surroundings

employees will be working in, from the point of view of health. Swampy terrain, for instance, requires careful study. Other factors include the altitude of the region, its seasonal temperature ranges, sewage and garbage disposal facilities, any insects, rats, snakes, or other pests nearby. The proximity and condition of local dwellings are important since they may have a direct bearing on flies, rodents and dogs (rabies).

If appropriate local housing is not available for expatriate personnel, a site must be selected and quarters constructed. The site should permit the most healthful living conditions, which, of course, are those most apt favorably to influence morale. Availability of amenities, recreational facilities—even the view—are important. Consideration must be given to the type of housing suitable for the area, the possible need for air conditioning; security and freedom from molestation.

For nationals to be employed, thought must be given to both the executive group and the laboring group. In arranging for housing for these groups, the same general considerations are followed as for expatriate housing, although tempered by a realization of the standards these groups are accustomed to.

In surveying local medical facilities, a number of steps should be taken. Hospitals and/or nursing homes should be visited and seen in operation to determine the standard of attention provided. The availability of medical staff—doctors, nurses and technicians—should be ascertained, and the calibre of their work evaluated. The availability of medical supplies, drugs and equipment should be checked. Much of this will be to insure medical care for national employees and their families.

Interviews with the Minister of Health and local health authorities are essential. The Health Minister can provide the over-all health picture, with any intended policies or plans under consideration. Local authorities can give details of public health codes of the area for water, sanitation, market and food inspection, and other matters in their jurisdiction. They also can report on various environmental diseases endemic in the region and provide general health statistics, if any, of the area.

It will be necessary to meet with government labor authorities, quarantine authorities and labor union leaders. These groups can inform of legal requirements for medical care of employees as set forth in the Labor Code. A copy of the Code should be secured for detailed study. Experience has shown that every country has different demands, ranging from practically no demands to inclusive and complicated regulations. Certain labor unions also may make local demands which must be complied with.

WEIGH AND DECIDE:

The data accumulated up to this point are now utilized to chart the necessary medical program for the operation.

All plans must be coordinated with the scheduled timing of the work at the site.

During construction work, it is a frequent practice to employ independent contractors. Generally, these have an insurance arrangement for handling their medical cases, consisting usually only of first aid. In certain areas, contractors demand that the operating company provide medical care.

Every effort should be made to secure high priority for the early construction of the project's permanent medical facilities. Until these are available, arrangements must be made for temporary shelter and equipment.

As construction nears an end, and the operating company's employees start taking over, the company's Medical Department must begin to function. There should be no lag in this, since it will be necessary at this time to carry out preemployment physical examinations, start the permanent health records, and assume medical care of expatriate employees and their families.

Selection of a staff to man the new medical installation is a very important matter. It is my company's policy to utilize national employees wherever they are adequate and available, and this, of course, applies to the medical staff as well as to other categories.

In operations near a large community, we have found it is often possible to appoint a capable medical officer on a part-time basis. He is then made responsible for staffing the company dispensary.

In isolated areas, it is necessary usually to import a full-time staff.

For large operations, a chief medical officer is selected and given responsibility for recruiting further staff, including additional doctors—if indicated by volume of work—nurses, technicians, and ward workers.

Small operations vary in their requirements. It is estimated that it takes a minimum of 700 to 800 potential patients to keep a good doctor reasonably busy and happy. Below this number, a good first aid man is indicated. This latter works satisfactorily in practice, although arrangements for transport must be made in event of unusual emergency. However, such emergencies occur rarely, and this should be stressed to all personnel.

Facilities required will vary in accord with the size of the project and the availability of local services. Near large communities, where hospitals or nursing homes can be utilized, a dispensary at the site will suffice. In remote areas, for small projects, there should be a dispensary with a detention bed, and well-stocked with first aid equipment and drugs.

Large projects in remote areas present the medical planner with his greatest problem. Usually a completely self-sufficient hospital is essential. It must include all modern x-ray, laboratory and surgery equipment; it must have oxygen tents, one or more ambulances, an extensive stock of medications. To allow transport time for replacements, all drugs and expendable items must be ordered in sufficient supply to last six to nine months.

Local conditions will determine the number of beds required in such a hospital. Sometimes, government regulations are fixed in this matter, calling for a certain number of beds per 100 employees. If not fixed by law, a safe estimate is two beds for each 100 employees, plus one bed for each 100 dependents. As the number of potential patients increases, these percentages can be lowered somewhat.

The type of hospital construction depends to a great extent on the locality, the terrain, local architecture, and local building materials available. The climate determines the need for air conditioning in most cases. One-story buildings have been found to be most practical under normal circumstances.

It is difficult to plan such a hospital precisely for long-range use. Generally, demands increase to such an extent that they outgrow the facilities originally planned. To some degree, this can be met by building additional wards, but this means that other sections of the hospital may become inadequate, and the building may ultimately simulate a tumor, with outgrowths protruding here and there. I am currently exploring the possibility of utilizing a reasonably inexpensive type of construction, with the idea of discarding the original structure in six or eight years, and building another hospital which will more nearly suit the demands at that time, but this plan still requires considerable thought.

Regardless of the type or size of the medical installations, all demand special services to meet conditions peculiar to their locality. Certain endemic diseases in the area may require special measures for control, sources of water may require special treatment to render the water suitable for human use, garbage and sewage disposal must be arranged, and pests may require specialized measures, such as mosquito control to prevent malaria.

TAKE ACTION:

As we enter the third phase of the program, the survey has been completed and the plans made.

Now the plans must be carried out.

First, the hospital or dispensary must be designed and constructed. The staff must be screened, hired, and instructed in its duties. Here the policies the staff is to follow must be drawn up clearly, and instituted. Equipment must be selected and ordered; delivery must be timed for installation at completion of construction. Stores also must be ordered for arrival at the same time.

And finally, a budget or cost estimate must be formulated.

CHECK RESULTS:

After the new department has been in operation for six months or a year, a thorough check study must be made to insure that it is accomplishing the purpose for which it was designed.

Staff members should be interviewed to ascertain their problems, if any, with over-all operations, with management, with outside personnel, and with materials and equipment. Management should be interviewed to learn its views on the manner in which the medical operation is progressing. All complaints and suggestions should be investigated, and, where indicated, action taken.

Patients, both expatriate and nationals, should be interviewed to determine if they are satisfied with the medical service. Here a certain amount of common sense is required in evaluation, as every medical man knows. It is understandable that all patients will not be completely happy with all members of any medical staff; such items as personal dislikes, past experiences and difference in nationalities may cause a patient to be hostile to and lack confidence in a certain doctor. This is not serious where two or more doctors are available. Where there is only one doctor, however, difficulties can arise and an investigation is needed. If a majority of the patients are dissatisfied, it probably is the doctor, and a change may be indicated.

If on the over-all follow-up survey, any faults are found to exist, the full facts should be secured. Then the proper remedy should be applied promptly.

Conclusion

IN THE petroleum industry, which has formed the basis for much of this report, it is obvious that production, manufacturing and sales provide the financial income that makes the industry possible and are the real reasons for its existence.

It is just as obvious, however, as in other industries, that such departments cannot function without a supporting cast. This is particularly true in isolated areas. It is necessary to have engineers and craftsmen to maintain the machines and equipment. It is equally necessary to maintain the physical and emotional well-being of the personnel, without which nothing can operate.

This outline should serve as a guide for the thinking and planning necessary in establishing an efficient medical organization for industries operating in the more remote areas. It is based not only on first-hand observation overseas, but also on experience gained in actually carrying out such programs in isolated regions of the world.

Industrial medicine frequently is taken for granted, i.e., until it fails to perform its job of human maintenance. But maintenance does not imply that repair work is the only important consideration.

Prophylactic maintenance should be the real aim for medicine in industry. It is a task which, well done, pays valuable dividends, even though they may not show up in the accountant's figures.

(Awali, Bahrain, Persian Gulf.)

The Tetanus Problem

—A PRACTICAL APPROACH

EARL F. LUTZ, M.D., Associate Medical Director
General Motors Corporation, Detroit

IN SOME ways it may seem that the subject here presented is elementary, and that most of the questions concerning tetanus immunization and prophylaxis were settled long ago. Nevertheless, during the past 10 years, one question has arisen repeatedly—"Just what is the best and most practical method of handling the tetanus problem?"—with reference not only to active immunization before injury, but also as to procedure which should be followed after the employee has suffered an acute injury.

How serious is the tetanus problem in industry? Relatively few deaths from tetanus are reported. In fact, investigation leads one to believe there are more deaths resulting from the injudicious use of tetanus antitoxin than from tetanus itself, and practically every physician has been confronted with at least several cases of ordinary serum sickness. At first glance, it might appear that the tetanus problem does not present much difficulty to industry, but nearly every one is confronted weekly and perhaps daily with the question, "Could this injury be contaminated with the tetanus bacillus, and should I give this man tetanus antitoxin?" The record in industry is such that all can be proud of the good judgment shown by industrial physicians in handling these cases.

Before attempting to answer the primary question, namely, "Just what is the best and most practical method of handling the tetanus problem?" it is believed some review observations are in order.

About a year ago, at the annual Michigan Industrial Medical Meeting in Kalamazoo, one of the speakers dwelt at considerable length on the question of tetanus immunization and prophylaxis. During the discussion period that followed it became apparent that the ideal program for active immunization as recommended by the U.S. Army and U.S. Public Health Service did not constitute a practical program for industry.

There are several reasons why the problem in industry is different from the problem in the Armed Forces.

First, it is impossible to lay down a rule in industry that immunization be compulsory.

Second, from practical experience it is quite apparent from the low incidence of tetanus among injured factory workers, who have not been immunized either actively or passively, that the presence of tetanus bacilli in the dirt found around factories is relatively infrequent.

Third, employees differ from soldiers in that prompt medical attention is always available to an injured employee while it is conceivable that an injured soldier might be cut off from medical service for several days. Also, the nature of the injuries is such that the possibility of having a wound contaminated with the tetanus bacilli is much greater among combat casualties.

Nevertheless, in spite of these points, it is only fair to note that in the event the industrial physician takes care of an injured employee who has suffered a puncture or contaminated wound and does not indicate by word or deed that he, the physician, has, at least, given thought to the possibility of tetanus infection—deciding it was or was not advisable to give supplemental prophylaxsis treatment—and subsequently the said employee develops tetanus, undoubtedly, he, the physician would be considered grossly negligent.

Another point one must bear in mind is that during the last 15 years there has been a great change in the American pattern of living. One of the newer trends has been the decentralization of industry by the construction of plants in and near small towns. There is a trend among all of us, including factory employees, to make our homes in rural areas. Many employees who formerly lived in cities, are now living on small farms—raising their own stock and tilling their own soil. Their shoes and clothing may easily become impregnated with tetanus bacilli and spores.

One might well say, "Sure these observations are true but what are we going to do about it?" The answer must be practical but, at the same time, it should be a trifle guarded. All agree with the Army authorities that 100% active immunization is ideal, but since this seems impossible it was felt that an effort should be made to contact several authorities on this subject and try to develop a practical approach.

AS A RESULT of our interest we submitted a short list of questions to several authorities on tetanus, among whom were Dr. W. C. Bunny, of Squibb & Sons, Dr. F. S. Leeder ,of the Michigan Department of Health, Dr. F. A. Top, Professor in the College of Medicine at the University of Iowa, Dr. Seward Miller, U.S. Public Health Service, and Dr. Alexander Lange Muir,

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Chief, Epidemiology, U.S. Public Health Service. The doctors thus approached were kind and prompt in forwarding their answers, and in most instances did not limit their remarks to the specific questions listed but volunteered personal opinions on specific methods for approaching this serious subject.

This limited survey consisted of the following questions:

DO YOU BELIEVE EVERY EMPLOYEE SHOULD BE GIVEN A COURSE OF TETANUS TOXOID AT TIME OF EMPLOYMENT?

Answer: The consensus from all the authorities was that ideally 100% active immunization should be provided. However, from a practical standpoint this was not found feasible. On the other hand, it was believed by the authorities that an industrial physician would do well to have the toxoid available and offer it to those interested, and, particularly, to encourage ex-Army men to have "booster" doses on the basis of one every five years. The five-year period has not been confirmed by research but there are developing indications that every 10 years may be sufficient.

WHAT WOULD BE YOUR RECOMMENDATIONS FOR EMPLOYEES WHO HAVE RECEIVED TETANUS TOXOID IN THE SERVICE BUT HAVE HAD NO BOOSTER SHOTS SINCE 1945?

Answer: The consensus was to the effect that a booster injection every five years after the first booster dose would be ideal, but with a 10-year lapse it was recommended that one-half booster dose should be given, followed in two months with another one-half booster dose. The contention was to the effect that although the titre against tetanus would be low or absent before the booster shots, the ability of body cells to react to restimulation by booster injection was good and response would be prompt. It is believed the one-half booster dose would be sufficient again actively to immunize the patient. However, I see no reason for not using the regular full dose ordinarily used in active immunization dosages.

ON PEOPLE WHO HAVE NEVER HAD TOXOID (IN THE CASE OF SEVERE INJURY) DO YOU ROUTINELY DO A SKIN TEST BEFORE ADMINISTERING ANTITOXIN?

Answer: The experts were 100% in agreement that a skin test should be done on all patients who are about to receive horse serum. One expert volunteered that in addition he, also, questioned the patient as to allergies which he or his family might have.

IF THE INDIVIDUAL SHOWS A SENSITIVE REACTION TO A SKIN TEST DO YOU ATTEMPT TO DESENSITIZE AND GIVE ANTITOXIN OVER A PERIOD OF SEVERAL HOURS?

Answer: Again the answer was 100% "yes."

DO YOU BELIEVE EACH CASE SHOULD BE HANDLED ON AN INDIVIDUALIZED BASIS CONSIDERING TYPE AND SEVERITY OF INJURY, LOCAL WORKING CONDITIONS, AND HOME LIFE OF EMPLOYEE?

Answer: The answer again was 100% "yes" that each case must be individualized as to both the employees' past history and type of past protection, as well as to the type and severity of the injury and the environment in which it occurred.

NOW AS TO recommendations. It is believed that procedure in various plants must be individualized depending on location of plant, type of personnel, and nature of industry. In other words we can only suggest some general rules, but the physician who knows his own local conditions is in a much better position to determine if these rules are practical, and must act accordingly. It is believed that the recommendations about to be offered particularly should be studied by Medical Directors whose plant populations come largely from rural areas—also, by those doctors who supervise the heavier industries, such as foundries.

The first recommendation is active immunization.

It is recommended that all new employees (and at a later date all old employees) be questioned as to whether they have or have not had tetanus toxoid. It can be assumed that those who have been in the Armed Forces since 1940 have received it. If the applicant has previously received tetanus toxoid, determine if a booster injection is advisable. If so, offer to give such an injection at that time. If the timing is such that a booster dose is not then indicated, earmark the chart so that the employee will be called in at the appropriate time. If the new employee has never had tetanus toxoid urge him to accept the two-dose immunizing course, being sure to explain that:

1. This is similar to the type of treatment given every soldier, and in the case of civilian disaster would be an extremely valuable protective agent.
2. In case of injury, it protects the employee against one of the most serious types of infection known.
3. Constitutional reactions occur only infrequently and are never severe.
4. Immunization is given without cost to the employee.

There are some authorities who feel so strongly about the advantages of active immunization that they urge management to have the employee sign a release in the event he is not willing to take the toxoid series. He is advised that subsequently, should he be injured, he would be responsible. I doubt that such a release would have legal standing. The employee's record, naturally, would need to be marked for "second" and "booster" injections to be given at a later date.

To continue—what action should be taken in the event this employee should be injured? If there is even a remote possibility that the wound might be contaminated, a "booster" dose of plain tetanus toxoid should be given immediately. This is preferable to the alum precipitated toxoid because its stimulating effects are more prompt. In such a situation, the physician always gives a great sigh of relief when he finds his patient has had previous active tetanus immunization. The physician's procedure is greatly simplified and the patient is fully protected. So much for active immunization.

Now, what to do for the employee who has had no active immunization but has suffered an injury which could conceivably be contaminated with tetanus bacilli? An injury, for example, such as a street accident in which roadside dirt has been ground into a wound, or a puncture in which a nail may have pierced the employee's shoe and subsequently his foot, and the employee may have been in the habit of wearing these same shoes while doing the chores on his little two-acre farm? Or the wound may have been of the crushing type in which considerable devitalized tissue results? All wounds such as these are ideal types for the future development of tetanus. Of course, our first thought is passive immunization, but here is where our trouble begins and it is all due to the fact that tetanus antitoxin is made from horse serum and many people are sensitive to the protein found in horse serum. This sensitiveness may be an inherent characteristic in an employee's individual physical make-up or it may have developed as a result of some previous medical treatment, such as an injection of diphtheria toxin-antitoxin in the employee's youth, or even a previous injection of tetanus antitoxin as protection from an earlier injury. Sensitization reactions can vary greatly both as to severity and time of occurrence. The most terrifying and serious reaction a doctor can be faced with is an anaphylactic shock which comes on within two or three minutes to an hour after the serum is given and can cause the death of the patient. One of these cases, even though the patient recovers, is enough to distress a doctor throughout a lifetime. He never forgets it!

As we all know, treatment must be extremely prompt if we have any hope of saving such a patient. It is recommended that whenever tetanus antitoxin is about to be given a syringe containing 1 cc. of 1:1000 adrenalin chloride solution, and also a tourniquet be placed on the same tray with the antitoxin ampule, syringe, etc. If this is done and a reaction should occur there will be no delay in treatment. Immediately administer the adrenalin subcutaneously. Then apply the tourniquet above the point where the antitoxin serum has been injected. The adrenalin should not be injected in the same area as the serum but in some other part of the body uninfluenced by the tourniquet so that absorption can take place readily. It goes without saying that in a case of acute anaphylaxis immediately discontinue any additional injections of tetanus antitoxin which might have been planned.

NOW A WORD about the milder but more common type of serum reaction—namely, ordinary serum sickness. This is somewhat delayed in appearance, coming on seven to 12 days after administration of the serum. It may manifest itself merely by a slight redness, itching and swelling in the local area immediately surrounding the point of injection of the serum, or it may appear as a severely itching dermatitis and urticaria covering the entire body. Other patients may react with relatively few skin symptoms but can develop moderate pain and swelling in the joints seven to 10 days after the initial injection.

Next there is the so-called "accelerated reaction." The primary portion of this reaction is local and occurs a few hours after the serum is administered. Secondary symptoms come on in four to seven days and are similar to ordinary serum sickness except that they may be more intense. Treatment here as with ordinary serum sickness is mainly palliative except for the use of adrenalin chloride. The "accelerated reaction" is more apt to occur in patients who have formerly received serum at some time.

In addition to the three types of serum sickness already mentioned we occasionally see the so-called "Arthus's phenomenon." This is a severe local reaction occurring in the subcutaneous and muscular tissue and usually occurs when a supplemental dose of antitoxin is injected a number of days after the initial injection. It can result in extensive sloughing. If supplemental doses of antitoxin become necessary some time after the initial dose, avoid the area of the initial injections. It is believed this assists greatly in avoiding this phenomenon. If at all possible, one should not allow more than five days to elapse between complementary or supplementary injections. If the time interval is kept below five days the possibility of Arthus's phenomenon is greatly reduced. This recital covers the main reasons why one views passive immunization with apprehension. Nevertheless, there are many times when every doctor is faced with the following questions which he must answer:

1. What are the possibilities that this man's wound is contaminated with tetanus bacilli?

2. Is this employee sensitive to horse serum? If so—to what degree?

It is impossible for any one to lay down a hard and fast rule which will cover every case. Each case must be judged on its own merits, giving consideration to the following points:

(a) What is the nature of the wound?

(b) Where did it occur and is it possible that tetanus contaminated material has entered the wound? (If it is non-occupational in origin, emergency treatment may be given, but refer this patient to his family physician and let him make the decision as to the advisability of tetanus antitoxin. However, I believe, the industrial physician should protect himself by advising the patient and probably the family physician in writing of this referral.)

(c) Is the wound a puncture wound, or is considerable devitalized tissue present?

After one has thoroughly appraised the wound and has decided that it is potentially contaminated it is now the duty of the industrial physician to appraise the patient. This begins with the taking of a complete history, being sure to question the patient not only as to his past illnesses and any serum treatments he may have taken, but also as to whether or not he, or his parents, have ever been afflicted with asthma or given any other history indicative of allergy.

This history should be followed with an in-

tradermal sensitivity test in every patient to whom you plan to give antitoxin. Your procedure here will be guided somewhat by the history. If there is no indication in the history that the patient is sensitive the skin test is usually done by injecting 0.05 to 0.1 cc. of a 1:10 dilution of the serum to be used into the skin of the volar surface of the forearm. Some doctors use one to two drops of the undiluted serum in making their intradermal sensitivity test, but the 1:10 dilution is considered more conservative. One authority, Bullowa, interprets skin reactions as follows:

"If the test is negative the elevation caused by the injection will disappear within a few minutes. In hypersensitive patients the elevation at the site where the serum is injected rapidly enlarges and within five to 20 minutes becomes urticarial in appearance, and is surrounded by a zone of erythema. To be significant," Bullowa states, "the wheal should be at least 10 millimeters in diameter and the erythematous flare 20 by 20 millimeters. Pseudopodial extensions of the central wheal are evidence of a higher or more dangerous degree of sensitivity.

"If the ophthalmic test for sensitivity is preferred to the skin test, it is conducted as follows: One drop of undiluted serum is placed into the lower conjunctival sac. A positive reaction is indicated by itching, burning, congestion and lacrimation. A drop of adrenalin 1:1000 will relieve these symptoms. If a positive reaction is not elicited in 15 minutes, it is generally believed that (with the exception of patients giving a history of horse allergy) dangerous hypersensitivity is excluded."

In the event the patient shows a severe reaction to the sensitivity test the doctor may decide that the wound is borderline (as to potential tetanus) and the danger from a severe reaction is greater than the risk of developing tetanus. However, in the event the patient shows a mild reaction or has a grossly contaminated wound and the doctor concludes that in spite of those hazards he still is almost forced to give antitoxin, the procedure for desensitization then is as follows:

Inject 0.1 cc. of the antitoxin subcutaneously and double the amount every half hour until the full dose has been given. Still greater precaution may be taken by making the initial subcutaneous injection of only 0.05 cc. of antitoxin. The dose again is doubled every half hour until the full amount has been given. After the first few subcutaneous doses it is usually safe to inject intramuscularly. Sometimes 10 or 12 hours are required in carrying out this method of desensitization. After an employee has been desensitized subsequent treatments by several routes may be given, usually without difficulty. Some authorities like to dilute the antitoxin serum in normal saline while giving the small desensitization fractions. One has a larger volume to work with and has better control of the dosage.

Of course, no one is expected to remember all the points covering sensitivity and desensitization. All of the manufacturers and suppliers of antitoxin as well as toxoid always include a leaflet in each package of their products which covers the important points that may confront the physician when he is about to give the product. Many of the points I have made are excerpts from a Parke, Davis & Company leaflet which accompanies their package of tetanus antitoxin. I cannot emphasize too strongly that a physician should never give a dose of antitoxin or toxoid until after he has carefully read the leaflet which accompanies that particular product. This leaflet may be printed in fine print, but experience indicates that this fine print is important.

Advances are continually being made by medical science and we frequently find minor changes occurring in the development of the antitoxin. This may require changes in our method of administration.

One other recommendation is in connection with patients to whom one has been compelled to give tetanus antitoxin. Every patient who receives horse serum in any form should, if at all possible, be called back by his physician at the appropriate time and be given active immunization with tetanus toxoid. Appropriate time is after the borrowed immunity furnished by the antitoxin has had an opportunity to wear off. If a patient has received 1,500 units of tetanus antitoxin the borrowed immunity will wear off in about two to three weeks. If he has received 10,000 units of tetanus antitoxin it will wear off in about six to 10 weeks, and if he has received 100,000 units of tetanus antitoxin it will wear off in about eight to 11 weeks.

SUMMARY: Appraise plant as to tetanus bacilli exposure:

1. Type of industry.
2. Type of plant population.

If you conclude that you have a tetanus exposure area under your supervision inaugurate an active immunization program on a low pressure basis.

1. Discuss the program with your management (manager and personnel director).
2. Recommend the procedure to the attention of new employees and if accepted by them administer toxoid.
3. After three to six months expand the program to include old employees returning from sick leave.
4. After another three months period expand the program to include employees receiving periodic examination.

When confronted by an employee who is suffering from an injury:

1. Appraise the wound as to tetanus prospects.
2. If the wound appears tetanus prone next appraise the employee:

(a) Give tetanus toxoid booster dose if the employee has had active immunization.

(b) If the employee has not received active immunization further appraise him by:

(i) Taking history.

(ii) Sensitization test.

(iii) If the employee is not sensitive give tetanus antitoxin (modified fractional technique).

If the employee is sensitive reconsider degree of tetanus proneness of the injury and degree of sensitivity. Determine subsequent action on an individualized basis.

If the physician decides the employee should receive tetanus antitoxin in spite of the risk of serum sickness desensitize the patient or ask for medical consultation.

In every case where tetanus antitoxin is to be given have (a) adrenalin chloride 1:1000; (b) tourniquet ready for immediate use in case of reaction.

Further, every patient receiving tetanus antitoxin should be followed up after borrowed immunity has worn off and actively immunized.

It is realized that many of the points made in this presentation are subject to differences of opinion, but I am convinced that every person would be better off if he received active immunization from tetanus, and I believe that indirectly industrial physicians have a responsibility to employees which can be at least partially carried out if this suggested program is adopted.

(General Motors Building.)

"The Sacred Work"

RESTORATION is at least as much a matter of spirit as of body, and must have as its central truth: body and the spirit are inextricably conjoined. To heal the one without the other is impossible. If the man's mind, courage and interest be enlisted in the cause of his own salvation, healing goes on apace; the sufferer is remade; if not, no mere surgical wonders, no careful nursing will avail to make a man of him again. Therefore, I would say: 'From the moment he enters the hospital, look after his mind and his will; give him food; nourish him in subtle ways; increase that nourishment as his strength increases. Give him interest in his future. Light a star for him to fix his eyes on so that when he steps out of the hospital, you shall not have to begin to train one who for months, perhaps years, has been living mindless and will-less, the life of a half-dead creature.' That this is a hard task none who knows hospital life can doubt. That it needs special qualities and special effort, quite other than the average range of hospital devotion, is obvious. But it saves time in the end and without it success is more than doubtful. The crucial period is time spent in the hospital. Use that period to re-create not only the body, but mind and will power, and all shall come out right; neglect to use it thus and the heart of many sufferers and many a would-be healer will break from sheer discouragement. A niche of usefulness and self-respect exists for every man, however handicapped; but that niche must be found for him. To carry out the process of restoration to a point short of this is to leave the cathedral without the spire. To restore him, and with him the future of our countries, that is the sacred work."

—From an address by JOHN GALSWORTHY, before the Allied Conference on the After-Care of Disabled Men, Washington, D. C., 1919; quoted by BEN L. BOYNTON, M.D., at the Sixty-Seventh Annual Meeting of the AMERICAN ASSOCIATION OF RAILWAY SURGEONS, Chicago, April 14, 1955.

The Lake Logan Conference on Occupational Health

CANTON, NORTH CAROLINA—MAY 20-22, 1955

INDUSTRIAL MEDICINE'S often-told complaint that "industrial physicians in their conventions talk only to each other," just for once was laid aside at the Lake Logan Conference. There, 15 industrial physicians from the country over, for a three-day period assembled with, and talked to and with, an equal number of industry's officers and executives and manufacturers' association officers and executives.

The Attitude

THIS WAS a "selfless" group. There were no "self-seekers." No formal objectives were declared, but in full simplicity the informal objective was to view the proper place, extent, function, and quality of occupational health in the industrial culture that indisputably has come to characterize America. Promptly and spontaneously there was agreement that occupational health is not a facility to be confined within the walls of industry but a facility that reaches out in its touch with the entire medical profession, the community, official health organizations, and hospitals, until in truth, it is a part of much of life in this country. Without debate recognition was extended to the industrial worker himself as the first, the chief, and the desired beneficiary of occupational health measures. If management benefits, if the community benefits, if the medical profession benefits from a high quality of occupational health, all that becomes secondary to the initial benefits provided to the industrial worker himself through activities directed to him and the work environment in which he goes about his duties. This Conference became a "swapping" camp, with occupational health ideas as the medium of exchange in an atmosphere free of pontification.

The Setting

THE setting in which this unhurried swapping of ideas took place perhaps provided the assurance of the constructiveness of the sessions. It is understandable that any large corporation engaged in the manufacture of wood-pulp paper products would be concerned with wide properties

of forests together with availability of enormous quantities of water for manufacturing purposes. The Champion Paper and Fibre Company is no exception. The exceptional is that that corporation has provided in the mountains at Lake Logan, near to its Canton mills, an incomparable social and working center chiefly for business purposes but with every appurtenance conducive to gracious entertainment. Cottages, lodges, lounges, dining halls, transportation, recreational facilities all in abundance were provided the "swappers." The host to the Conference was The Champion Paper and Fibre Company. This host was personified in Reuben B. Robertson, Chairman of the Board. This genial and untiring gentleman participated in every session, day and night. The ruggedness and the beauty of the Lake Logan Camp are a portrait of Reuben Robertson.

The Sessions

THE temptation was to play. The urge was to work. Work won. Four organized discussionals were arranged, but the unarranged discussions went on endlessly by twos and sixes and tens. The last thing that might have been contemplated was "across the table" conversations with the industrialists on one side and the physicians on the other. In short time there were no industrialists nor any physicians, just planful, earnest human beings. If in this unharrassed setting occupational health could not have been approached creatively and constructively, then all has failed. But the Conference did not fail.

At no time was it the purpose of this Conference to formulate pronouncements in the hope that these would reflect formal attitudes. In fact, no effort was exercised to bring about unanimity of opinion. Notwithstanding, the exploration provided consensus in many areas. Without committing this Conference to any exactness in appraisal, a number of items are here presented as representative of the trends of discussion:

The first arranged session considered the economics of occupational health. Directly the question was proposed "Does occupational health demonstrably pay for itself in money?" The physician group adduced many figures unequivocally proving that by almost any system of accounting the industrial Medical Department, through savings, not only pays its own way but in high frequency leads to profits. Chiefly the visible monetary values reside in reduced insurance costs. Somewhat unexpectedly the industrial group gave assent to these claims and then promptly brushed aside money savings through Medical Department effort as being unimportant and constituting the least desirable yardstick of value. It was observed by some industrialists that there was a preference that the Medical Department should make no effort to establish its monetary worth, and should it come about that a monetary gain arose, this should be re-entered into the Medical Department for expanded services. The over-all estimate of the situation was that it was no function of the Medical Director to provide conviction to management of occupational health money values. The bigger worth is not to be measured by dollar signs.

A meeting of minds was reached as to the position of the Medical Director and the Medical Department in connection with labor relations. Decisive were the opinions that the Medical Director or his associates should not engage in labor bargaining or arbitration of disputed matters and

The temptation was to play . . . . .

The urge was to work.

should go no further than serving as the adviser, but might well advise both management and labor organizations. Apart from bargaining tables, it was contended and agreed upon that the industrial Medical Director loses his proper status under all circumstances where he aligns himself in partisanship with either management or labor groups.

Strong support was provided the physician group in its contention that the Medical Department should function as an autonomy after the basic medical program had been endorsed by management and after the Medical Director had established himself in a position of trust in the organization. Most of all was the consensus that management in no degree should attempt to operate the Medical Department, the Medical Director being an instrument merely for carrying out directives from lay supervisors. It became apparent that not all management would subscribe to the reporting of Medical Directors to the highest officials, the belief being that secondary and tertiary management often exercises judicious authority suitable to just operations within the medical domain.

Astonishing to some industrial physicians was the revealment by some industrialists that one of the trouble making practices of labor groups was to emphasize among their members that favoritism was extended in medical services to management members in contrast to the rank and file of workers. It was pointed out that the physical examinations extended the average worker in the absence of demonstrable disease might represent an expenditure of time such as 20 or 30 minutes while an executive's examination might be extended over a period of two or three days. The medical group aggressively denied this representation and used, for example, the treatment that might be provided in the instance of a broken leg. Beyond debate, the medical or surgical ministration would be identical in the two instances. It was agreed that the workman, depending upon his needs, might be located in a ward in a hospital and that contrawise, a vice-president might be hospitalized in a corner, private room. However, it was noted that all such refinements were rightly to be at the direct expense of that member of management.

Another revealment to many was that proper motivations, the creation of wanted loyalties, the establishment of satisfactions and many other such considerations within the work force will not necessarily come about through "things." Instances were pointed out in which management made large expenditures in providing almost the perfect environment for work, including workplace air conditioning, recreational facilities, superb industrial hygienic conditions, all in the expectancy that this would lead to hearty responses on the part of the work group. Repeatedly such measures have failed unless all those innovations were accompanied by appropriate emotional stimuli and corresponding responsiveness.

The industrialist group displayed enormous perplexity and even dissatisfaction over what they termed "physicians' ethics." Direct fault was found with the lately promulgated "Guiding Principles of Occupational Medicine." This, by some, was regarded as an instrument wholly for the protection of physicians in and out of industry. In particular, condemnation was directed

Conference Host, Mr. Reuben B. Robertson, (left); Mr. R. J. Stockham (center); Dr. Arthur K. Peterson.

against some local medical societies that refuse membership for all physicians who carry out their activities on a salary basis and who otherwise do not conform to the general pattern of private practice in a personal office. Not always were the industrialists in accord with the physicians' well-nigh universal withholding of medical records from management. Management asserted that on many occasions the interest of the workman or worker patient would be served by better understanding of the needs in various situations. The physicians did not yield on this score, demanding the continuation of the right of every workman to have his medical affairs protected by privacy. Manifestly, it was recognized that all physicians under some circumstances, such, for example, as the appearance of a case of smallpox or typhoid fever, would reveal to management the circumstances because of the need for the protection of fellow workmen. Also, in the instance of a workman with open lesions of tuberculosis, the physician would have no compunction in stating openly, but judiciously, his reasons for debarring that workman from further work for the time being, in behalf of both the workman himself and those about him. It was pointed out by the industrialists that, in almost every form of industrial medical activity, some workmen patients must be sent off the premises to consultants, to other physicians, and to hospitals. Scathing were the complaints that many such workmen, despite appointment hours, are called upon to wait two, three, or four hours in physicians' offices without apparent justification. The physicians present admitted this practice on the part of some private physicians, were unwilling to condone it, and joined in the condemnation.

A little aside from medical pursuits, some industrialists displayed an eagerness to extend added recognition and favors to those workers in high and low places, including managerial positions, who unequivocally earned and deserved such recognition. The difficulties attending the application of this desire were manifest. Length of service alone was accorded little support as a yardstick for recognition. It was contended that the provision of three weeks of vacation (for example) for groups of workers after a fixed number of years of employment was perhaps desirable, still there might be other workers fully deserving of vacations that long or longer after only a third of the length of service, while still other workers on a basis of deservedness might be entitled to no paid vacation at all. It was wholesome to encounter the desire of management to recognize contribution, and in some manner to extend to the worker some reward for contributions, and all on an individual basis. Management is none too happy with now widespread provisions that tend to reduce all workers to a common denominator when consistently there appear occasions for individual preferment.

The entire group concurred in the belief that in recent generations management in particular had failed to appraise, in proper setting, the industrial worker as a human being and to explore that worker's sources of satisfaction, his motivations, his desires to participate and communicate. The essence of the discussions centered about appeals to high-minded emotion as something that tremendously has been neglected in industrial life in recent decades, and that this applied to all workers including management. It was granted that management has lost the hearing ear of labor, and that the prime reason for this loss

Discussions by no means ended with the formal sessions.

has been too much emphasis on "things" and too little emphasis on the emotional life.

These topics, sketchily presented, reflect the content of the Lake Logan Conference, but there are no less than 100 other items that might have been introduced as representative.

The Participants

THOSE invited to Lake Logan, including the names of the hosts, are here presented chiefly to indicate the high quality of spokesmen from both the industrialists and the industrial physician groups:

ADAMS, R. S., Secretary-Treasurer, Hardwood Corporation of America.

AMDUR, DR. MARVIN, Medical Director, Buffalo Industrial Medical Center.

ANDERSON, A. S., Personnel Director, Champion Paper and Fibre Company.

BLACK, S. BRUCE, President, Liberty Mutual Insurance Company.

BRICKNER, J. J., Personnel Director, IBM Corporation.

BURLING, DR. TEMPLE, Professor, School of Industrial and Labor Relations, Cornell University.

COOLEY, GEORGE W., Associate Secretary, Council on Medical Services, American Medical Association.

DELONG, HENRY, Manager, Lamp Division, General Electric Company.

EVANS, DR. O. D., Consultant, Occupational Health.

FORBES, T. M., Executive Vice-President, Cotton Manufacturers of Georgia.

Dr. Logan T. Robertson (center), Medical Host of the Conference.

Dr. Kehoe and Dr. Shepard plan the last session.

GARRETT, ROSS, Executive, Foundation for Research and Development in Health.

HARDEN, JOHN W., Vice-President, Burlington Mills Corporation.

HARKINS, HERSCHEL, President, DiSer Corporation.

HOWARD, DR. ERNEST B., Assistant Secretary, American Medical Association.

HICKERSON, DR. WILLIAM D., Medical Director, Union Central Life Insurance Company.

HUFFMAN, R. O., President, Drexel Furniture Company.

JONES, DR. E. S., Vice-President, Industrial Medical Association.

KEENER, WARD, Vice-President, B. F. Goodrich Rubber Company.

KEHOE, DR. ROBERT A., Director, Kettering Laboratory.

KLINE, DR. EDWARD, Medical Director, Lamp Division, General Electric Company.

KLUSS, CHARLES, Partner, Edwin Shields Hewitt Associates.

LAUER, DR. D. J., Medical Director, Jones and Laughlin Steel Corporation.

LEVER, CHAUNCEY, W., Director, Industrial Relations, Erwin Mills.

MCCAHAN, DR. J. F., Division Medical Director, Liberty Mutual Insurance Company.

MCCORD, DR. CAREY P., Consultant, Institute of Industrial Health, University of Michigan.

MILLER, DR. SEWARD E., Chief, Division of Special Health Service, U.S. Public Health Service.

MOFFIE, D. J., Head, Department of Psychology, North Carolina State College.

NEWMAN, L. E., Manager, Education and Training Services, General Electric Company.

"It deserves commendations; it is an art worthy the practice of a wise man."
Carl Peterson and Jack Jones

NICHOLSON, GUNNAR, Vice-President, Union Bag and Paper Company.

O'CONNOR, DR. R. B., Medical Director, Loss Prevention Bureau, Liberty Mutual Insurance Company.

PETERSON, DR. ARTHUR K., Medical Director, R. R. Donnelley and Sons.

PETERSON, DR. CARL M., Secretary, Council on Industrial Health, American Medical Association.

POWELL, WALTER H., Director, Industrial Relations, International Resistance.

ROBERTSON, DR. LOGAN T., Consultant, Occupational Health.

ROBERTSON, REUBEN B., Chairman of Board, Champion Paper and Fibre Company.

SAWYER, DR. WILLIAM A., Medical Consultant, International Association of Machinists.

SHEPARD, DR. WILLIAM P., Vice-President, Metropolitan Life Insurance Company.

SORKEY, DR. HERMAN, Psychologist, North Carolina.

STOCKHAM, R. J., President, Stockham Valves and Fittings.

THOMSON, DWIGHT, Vice-President, Champion Paper and Fibre Company.

TYROLER, DR. H. A., Consultant, Occupational Health Service.

YOUNTS, C. R., President, Plantation Pipe Lines.

ZERFOSS, LESTER, Industrial Relations, American Enka.

PHYSICAL limitations alone governed the size of the participating group in this Conference of occupational health exploration. Prior to the Conference itself it was likely that no thought was given to the perpetuation or repetition of the occasion. The manifest success of this Conference prompts the belief that similar assemblies at early times may be provided, since clearly over the land there are many other physicians and industrialists in addition to those lately in attendance who could make contributions.

The singular, remarkable quality of this Conference was that it was brought about—that it was achieved. At last the industrialist and the physician sat down together, each with a hand on the knee of the other, and made plans for occupational health at its best.

Yardstick for Directors

HOW effectively or how badly a Medical Department functions should be one of the many useful yardsticks for Directors when they are wondering whether the company needs a new head."

—From "A Better Place to Work," by WILLIAM B. GIVEN, JR.; Keynote address, Twelfth Annual Meeting, Industrial Hygiene Foundation, November 20, 1947.

The Role of Trauma in Arthritis

—ONTARIO WORKMEN'S COMPENSATION BOARD

WM. J. McCRACKEN, M.D., B.Sc., F.R.C.S. (C), M.S.
Toronto, Ontario, Canada

THE ROLE of trauma in the production and or aggravation of arthritis represents a vast and controversial field in medicine. It would be impossible to present this subject in one day, much less in 20 minutes. I shall therefore attempt to select certain phases of it, especially drawing on subject matter and experience as encountered in cases passing under the care of the Ontario Workmen's Compensation Board.

1. DEGENERATIVE ARTHRITIS OF THE SPINE:

This represents the greatest number of arthritic cases seen by the W.C.B. It also represents one of the most difficult problems in attempting to assess the Board's responsibility.

This disease is present in a high percentage of people over the age of 35 years, and yet we estimate that close to 80% of all cases are essentially asymptomatic. Therefore it would appear that radiological changes of spine are proof of degenerative disease, but have no correlation to the presence of disabling back syptomatology.

The usual story in the cases seen at the W.C.B. is that of a middle aged worker who injures his back owing to a blow, slip, fall, unusual lifting strain or twist. He becomes disabled due to back pain. X-rays are taken by the attending surgeon and degenerative disease of the spine is noted by the radiologist. The surgeon then sends us a report that the man is suffering back pain from arthritis of the spine, brought on by injury.

This constitutes an interesting problem. We admit that trauma may act to aggravate an osteoarthritic spine, and thereby give rise to back pain. However, we are also convinced that in a reasonable percentage of these cases the radiological discovery of degenerative disease is merely coincidental. We prefer to consider these cases as low back strain due to soft tissue strain and sprain. In any event the treatment is initially the same, and if recovery occurs within four to 12 weeks no great problem is met.

Three types of cases present problems as to the degree of our responsibility as related to the compensable accident.

(a) In those cases which continue to have back pain and remain disabled for prolonged periods of time, the problem is to determine the limits of responsibility. This necessitates separating the portion and degree due to the injury from the like portion and degree due to the pre-existing degenerative process.

It has been suggested that, in the absence of fracture, dislocation, or clear-cut disc disease, these cases be treated as a soft tissue low back strain. Accordingly, compensable responsibility should be terminated at an arbitrary time limit of six months, or when the cases have returned to their pre-accident status, whichever occurs first. I may add here that most of our cases in which an adequate accident has occurred, are carried on far beyond this point.

(b) The second type of difficult case is where the workman recovers with minimal back discomfort and returns to work. At a later date (six to 36 months) he becomes disabled again, without subsequent accident, due to back pain. He or his physician attributes this disability to his compensable accident. In the vast majority of these cases we feel that the relationship to the accident is remote and do *not* accept further responsibility.

(c) There is a small third group which I should like to add here. This group becomes considerably larger when disc cases (operative and non-operative), spondylolisthesis, and fractures are added in. It is represented by the elderly workman who recovers to a degree only. Owing to his residual disability, age, the general labor market, etc., he never returns to work. In effect his working days have been shortened. This is due to a speeding up of wear and tear phenomena, resulting in his retirement from the labor market one to five years prematurely. This factor is taken into account and the Board accepts a limited degree of continuing responsibility.

2. FRACTURES OF THE SPINE WITH LOCALIZED ARTHRITIC CHANGE:

We see considerable numbers of these cases, usually in the final static phase, three to five years following injury. They are mainly compression fractures of lumbar and lower dorsal vertebral bodies. There are a few fractures of the articular pedicles and transverse processes. The usual case continues to have minimal to moderate back pain without great deformity. He is unable to do heavy labor, despite the fact that he is a relatively young man. In most instances his initial treatment has been proper and adequate. X-rays of the spine show a localized de-

Presented at a joint meeting of the Industrial Section of the Ontario Medical Association and the Industrial Medical Association of the Province of Quebec, Ottawa, September 23, 1954.

generative process with spur formation and incomplete bony bridging of the anterior intervertebral space in the region of the annularis. The remainder of the spine is free of evidence, on radiological examination, of degenerative change.

Fractures of articular pedicles and transverse processes which go on to non-union, or fibrous union are a cause of pain. They will show proliferative changes about the fracture line. Degenerative disease involving the articular facets of the offending vertebra is also noted.

These all represent direct sequelae to the injury, and our responsibility is evident.

3. MARIE-STRUMPELL SPONDYLITIS:

It is of interest that we see so few of these cases. This may be due to these people not being engaged in heavy industry, as a result of their disease. Another possibility is that a case, which has run its course and become static, is less prone to back strain due to the auto-fusion that has already occurred.

We see the occasional case of early spondylitis with a low back strain, but by and large these do not tend to become chronically disabled as a result of accident. We concede that adequate injury will play the role of an aggravating factor in the early stages of the disease, but we are not convinced that it materially speeds up the disease process.

4. POST-TRAUMATIC ARTHRITIS:

Here I should like to consider arthritis occurring in joints other than the spine.

In fractures of bones adjacent to joints, if the fracture passes into the joint with displacement of part of the articular surface, or if the fracture disturbs the joint dynamics due to bony deformity, then traumatic arthritis supervenes.

Excellent examples may be found following comminuted fractures of the os calcis with distortion of the subastragaloid joint space. An example of upset joint dynamics is found in mal-union of the tibia with angulation and resultant arthritic change in the ankle joint. Another two joints especially prone to traumatic arthritis are, the knee joint following fractures of the tibial plateau with distortion and depression of the fragments, and, the ankle following trimalleolar fractures.

Arthritis of joints, such as elbow, following dislocation is occasionally seen and usually associated with calcification in a subperiosteal hematoma and loose bodies in the joint.

Arthritis of the knee joint following meniscectomy is fortunately rare, but does occur. We feel the arthrotomy tends to speed up an early pre-existing osteoarthritis, in these cases, rather than cause a true traumatic arthritis.

We are unable to attribute any cases of traumatic arthritis to repeated minimal trauma, or continued excessive strain on the joint, except where the joint dynamics are disturbed as previously mentioned. Possibly the closest entity to this is the so-called "moulders back." Here, however, we feel the lesion is degenerative arthritis speeded up due to excessive wear and tear phenomena as a result of occupation.

5. ARTHRITIS OF ASEPTIC NECROSIS (KEINBOCH'S DISEASE, LEGG-PERTHES'S, OSTEOCHONDRITIS DESSICANS, TRAUMATIC DEAD HEAD OF FEMUR):

We see numerous cases of Keinboch's disease with associated traumatic arthritis. This always represents a pre-existing condition, brought to our attention by a twist or sprain to the wrist. In these cases we recognize that trauma may act as the final precipitating factor in the development of a painful wrist. We feel that trauma has no influence on the disease rate, nor on the arthritis present. However, the trauma may cause collapse of the diseased semilunar with a resultant increase in the associated arthritis.

Occasionally we see aseptic necrosis following anterior dislocations of the semilunar. This condition is always the cause of traumatic arthritis in the offending wrist joint.

One case of Legg-Perthes's disease has been brought to my attention. This young man had developed a painful hip at the age of 11 years and following investigation a diagnosis of Legg-Perthes's disease was made. He was not confined to bed, and represents one of the cases which became pain-free. He carried on without symptoms till the age of 16, when he was involved in an accident. He received a blow of considerable force to the region of the greater trochanter, developed a painful hip and was disabled for 18 months. The hip joint showed the pre-existing femoral head deformity with associated traumatic arthritic changes. The x-ray picture remained unchanged. He finally became pain-free and now is able to walk five miles without discomfort.

Osteochondritis dessicans—I mention this disease to point out that we are convinced that trauma plays a very minor role in its production and exacerbations. The usual lesion is restricted to the non-weight bearing portion of the femoral condyles and antedates the injury. The only direct result of trauma is when the diseased area is separated at the time of injury and becomes a loose body in the joint, with resultant joint locking and effusion. Occasionally we see traumatic arthritis as the end result of an old osteochondritis in which the loose body has not been removed by arthrotomy.

Periodically we encounter cases of osteochondritis involving the humeral capitellum, and the lateral portions of the superior articular surface of the astragalus. These have been related to definite trauma and may eventually result in the development of a traumatic arthritis.

Dead head of femur—Following posterior dislocation of the femur from the acetabulum the blood supply to the head is interfered with. This is due to trauma with thrombosis of the vessels running along the capsule of the joint. As accurately as we can estimate 15-25% of these cases develop a dead femoral head. If this condition is not recognized, then fragmentation of the head occurs from continued weight-bearing, and a painful traumatic arthritis develops. In several of these cases the arthritic process has involved the acetabulum to such a degree that arthroplasty has failed to relieve the pain.

6. ARTHRITIS ASSOCIATED WITH NON-UNION OF CARPAL SCAPHOID AND WITH DEAD PROXIMAL POLE:

This problem is somewhat comparable to Keinboch's Disease. We see many cases of non-union, or fibrous union, of scaphoids which apparently have been asymptomatic up to the time of sprain or strain. In the x-rays taken immediately following the accident the old fracture is noted and shows sclerosis with cystic degeneration. The adjacent joint space shows marked degrees of traumatic arthritis. It is of interest that the patient states that he has never been bothered with pain in his wrist before. It is partially because of this observation that we tend to reject the views expressed by Sir Reginald Watson-Jones. He advocates immediate surgical excision of the proximal pole as soon as a radiological diagnosis of devitalization is made, in order to guard against a painful arthritic joint. Our policy now is that of prolonged immobilization in plaster and periodic radiological re-checks taken out of plaster. If the proximal fragment dies and there is no evidence of union with revascularization, after 12 weeks of continued immobilization, then we recommend bone grafting with a peg across the fracture line and into the dead fragment. If the fragment is too small to accept a bone peg, then excision of the proximal fragment should be carried out. Our results are as good as early excision from the standpoint of painful arthritis, and the results of the many cases which revascularize are far superior.

7. RHEUMATOID ARTHRITIS:

In our opinion, trauma does not play a role in the development of rheumatoid arthritis. We agree that trauma may aggravate a rheumatoid arthritis already present in the joint traumatized.

Rarely we encounter a truly perplexing problem in assessing the role of trauma in rheumatoid arthritis. One case I should like to cite concerns a workman who had previously been well. He sustained a blow to his wrist and hand. X-rays were negative for fracture, dislocation, and arthritic change. He went on to develop polyarthritis, and became a clear-cut case of the rheumatoid type. It was thought that the trauma must have acted as the precipitating insult in a case that was in a pre-rheumatoid arthritic phase.

Another case to be cited (not one of our cases) concerns a man with a prior history of rheumatoid arthritis. He received a blow to his knee. The knee became swollen and painful, and an acute exacerbation of all his previously affected joints occurred. Here it was considered that the trauma caused a general reactivation of a smouldering rheumatoid arthritis.

I should like to mention one more case. This workman sustained a blow to his ankle. It became swollen and painful. During his convalescence he underwent extraction of his teeth which were diseased. He developed acute pain and swelling in the injured ankle, and then polyarthritis. It was considered that the injury to his ankle predisposed this joint to the initial rheumatoid attack.

8. GOUTY ARTHRITIS:

Trauma does not cause gouty arthritis. However, trauma may aggravate and precipitate an attack of gouty arthritis.

We have a case on record of a middle aged man who sustained a blow to his foot and a fractured tip of medial malleolus. He developed a swollen big toe and ankle joint. He did not respond to salicylates, but showed a rapid response to colchicine. A diagnosis of gouty arthritis was made. He has had recurrent attacks which have continued to respond rapidly to colchicine.

It has been our policy to accept responsibility for the treatment of the initial attack which follows trauma.

9. REITER'S SYNDROME:

We have recently encountered two cases of Reiter's syndrome. The first was that of a young man who sustained multiple bruises to his leg, a small hematoma to his thigh, and a blow to his patella with early evidence of knee effusion. He convalesced satisfactorily from these injuries, and about the time he was ready to leave the hospital he developed a polyarthritis, conjunctivitis, and fleeting urethritis. A diagnosis of Reiter's syndrome was made. It was felt that it must be considered coincidental to his injury.

The second case was a young man who sustained a severe sprain of his ankle. The joint became swollen and painful and he was unable to walk on it. Several days later he developed polyarthritis, conjunctivitis, and urethritis. A diagnosis of Reiter's syndrome was made. It was concluded that the trauma to his ankle had acted as the precipitating factor, and the Board accepted a limited responsibility in his treatment.

10. REFLEX NEUROVASCULAR DYSTROPHY:

I should like to mention our only case which has gone on to radiological arthritic change. This is the case of a young woman who sustained a minor blow to the dorsum of her hand. The hand was slightly swollen and painful, and there was a subcutaneous hematoma. The hand, wrist, and lower third of the forearm subsequently became cold, clammy, blue and swollen, and extreme pain was experienced. The arterial supply was normal. A diagnosis of reflex neurovascular dystrophy was made, and stellate ganglion blocks were given. She obtained responses of short duration. The condition continued unabated. A cervical and upper dorsal sympathetic ganglionectomy was performed. She had a good response, the hand became warm and pink and the edema partially disappeared. The pain was alleviated but returned in a few weeks. Her disability continued. She had developed extreme osteoporosis of the carpals and metacarpals. After six months the carpal and radiocarpal joint spacing was markedly narrowed and irregular. A radiological diagnosis of traumatic arthritis was made. Finally, despite plaster immobilization, rest, and several courses of cortisone, a formal wrist fusion was necessary to alleviate the pain.

As may be appreciated, the role of trauma in the production and aggravation of the various forms of arthritis is a complex problem constantly being brought to the attention of those of us who deal with compensation medicine.

Industrial Medical Association

President's Page

FOR 40 years the Industrial Medical Association has continued to grow—sometimes rather slowly, and sometimes rapidly—both in membership and in prestige. During the past 10 years the membership has more than tripled, and I believe we can properly say that broadened interests have increased accordingly.

As we all know, growth does not occur without concomitant problems. IMA is no different. Our problems have naturally pyramided in the recent past; however, the foundations established by our predecessors have been strong enough to withstand the trials of time and to furnish the "basement" upon which our present-day Association is developing.

Certain progressive and constructive reorganizational changes began only a short time ago. The present organizational chart which you see on the opposite page reveals just how complex our IMA has become. The general extension of IMA purposes, along with our ever-increasing interests in the problems connected with the practice of medicine in industry, necessitates current and modern mechanisms with which and through which this work can be accomplished.

Under the present-day philosophy the Association no longer is guided entirely by the tops of its executive committee, with the Board of Directors sitting in session occasionally to approve the work going on. All the officers are assigned specific duties in the over-all Association organization. Furthermore, these duties are arranged in such a manner that there will be a continuity of function from year to year, All in all, there are now over 200 members taking a really active part in the Association's business. Through this organizational set-up, avenues have developed which will permit free and easy exchanges of ideas—a two-way communications channel through which information can pass from counselors and committees to top levels, and suggestions and assistance from top levels to those working at the Association's "grass-root" level.

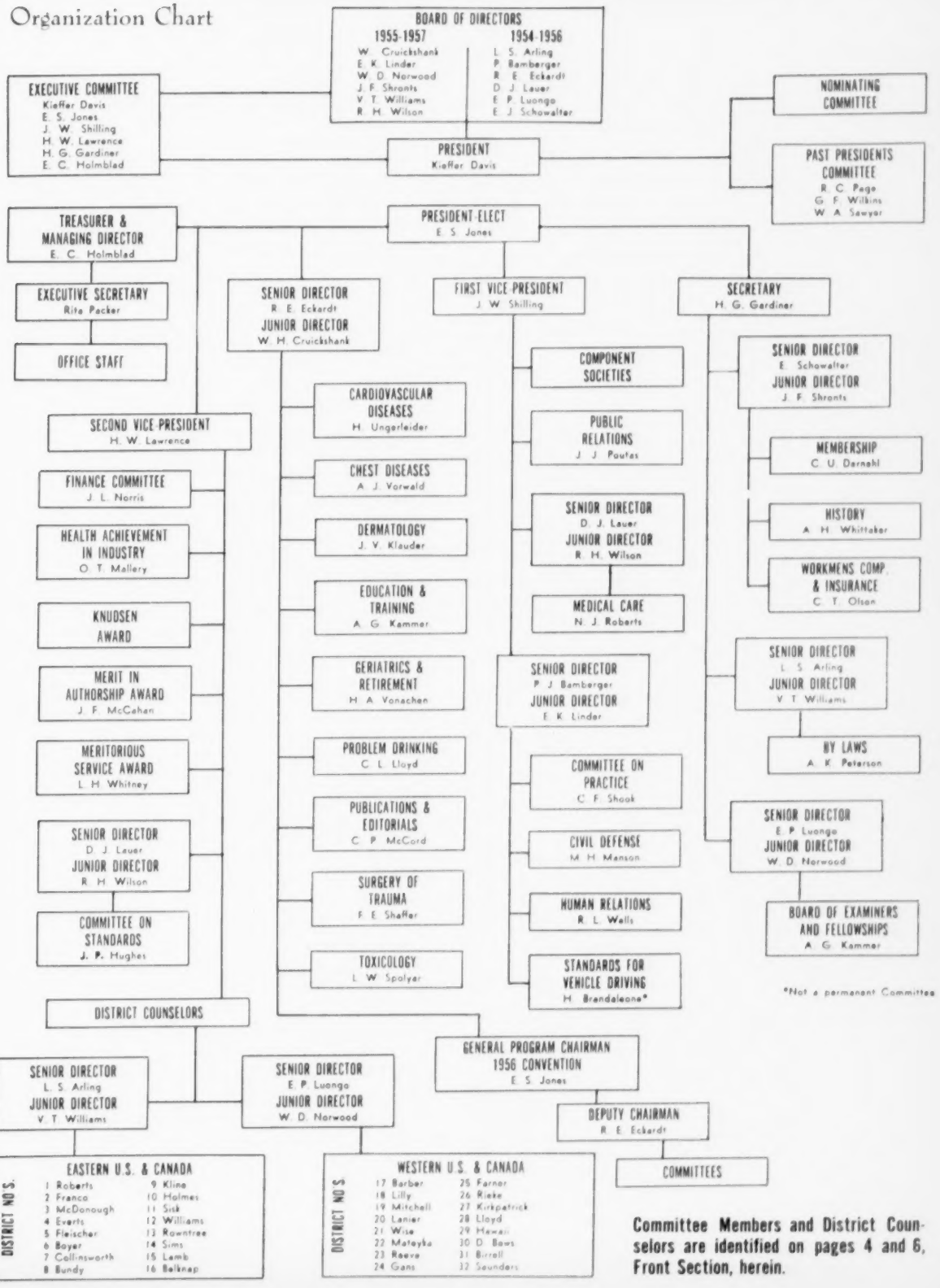
It has been mentioned before, and on this page, that the interest of Association members in their work on behalf of the Association, no matter what this work may be, may have a great deal to do with the selection of nominees to the Board of Directors. And the manifestation and effectiveness of interest, on the part of the Directors, in the more important needs of the Association are likewise important when it is time to make nominations for the executive committee.

I sincerely hope this picture will reveal that the credit for the Association's progress can no longer be claimed by a few, but that it belongs to each and every one intimately connected with the organization. This is "teamwork" in the truest sense of its meaning.

Kingsley Davis, M.D.

Industrial Medical Association

Organization Chart



Committee Members and District Counselors are identified on pages 4 and 6, Front Section, herein.

Occupational Health Institute

FRANK A. CALDERONE, M.D., of Great Neck, Long Island, Consultant on Industrial Medical Relations and former Director of Medical Services of the United Nations Secretariat, was elected President of the OCCUPATIONAL HEALTH INSTITUTE, INC., at the first Annual Meeting of that organization held in New York City last month. DR. CALDERONE succeeds DR. ROBERT COLLIER PAGE. DR. CALDERONE was formerly Deputy Commissioner of the New York City Department of Health, and Director of the New York office of the World Health Organization.

STEPHEN G. HALOS, President, Industrial Medicine Publishing Company, Miami, Florida, was elected Vice-President.

DAVID W. BLACK, Assistant to the President, Warner-Lambert Pharmaceutical Company, New York, was elected Treasurer.

MRS. MARGARET S. HARGREAVES, R.N., Executive Director, American Association of Industrial Nurses, New York, was elected Secretary.

NEW DIRECTORS of the INSTITUTE were elected as follows: CHARLES E. DUTCHESS, M.D., Medical Director; Schenley Industries; H. W. LAWRENCE, M.D., Medical Director, Procter & Gamble; ROBERT COLLIER PAGE, M.D., Medical Management Consultant; WILLIAM H. SEYMOUR, Vice-President, Liberty Mutual Insurance Company; THOMAS J. WINN, Vice-President, Charles Pfizer & Company, Inc.

Among the other Directors of the INSTITUTE are: E. H. CARLETON, M.D., General Medical Director, Inland Steel Company; KIEFFER DAVIS, M.D., Medical Director, Phillips Petroleum Company; PROFESSOR PHILIP DRINKER, Harvard School of Public Health; GEORGE H. GEHRMANN, M.D., Associate Medical Director, E. I. du Pont de Nemours & Company; E. S. JONES, M.D., President-Elect, Industrial Medical Association; A. G. KAMMER, M.D., Head, Department of Occupational Health, University of Pittsburgh; GORDON H. SCOTT, Ph.D., Dean, Wayne University College of Medicine; GEORGE F. WILKINS, M.D., Medical Director, New England Telephone & Telegraph Company.

MRS. BEATRICE FIELD was named Executive Secretary of the INSTITUTE.

The complete list of Officers and Directors appears on page 12 herein.

THIS ANNUAL MEETING of the OCCUPATIONAL HEALTH INSTITUTE was marked by receipt from the Rockefeller Brothers Fund of a grant for $22,500. The contribution, announced by DR. ROBERT C. PAGE, was the 150th gift — and the first from a voluntary Foundation — received by the Institute since the establishment of its program 15 months ago.

Corporations and Foundations that have contributed $1,000 or more to the 1955 effort of the INSTITUTE include: Inland Steel; Bethlehem Steel; Caterpillar Foundation; Standard Oil Company (New Jersey); General Electric Company; Procter & Gamble Fund.

American Academy

AMERICAN ACADEMY OF OCCUPATIONAL MEDICINE'S Board of Directors met at Atlantic City June 7, 1955. Among the actions taken by the Board was the election to membership of: GRANT ROOSEVELT ELLIOTT, M.D., Veterans Administration Hospital, Richmond, Virginia; DAVID H. GOLDSTEIN, M.D., *The New York Times*, New York; MORRIS KLEINFELD, M.D., New York State Department of Labor, New York; HALLETT A. LEWIS, M.D., Kettering Laboratory, University of Cincinnati, Cincinnati, Ohio; IAN MACLACHLAN, M.D., Carrier Corporation, Syracuse, New York; LEMUEL C. McGEE, M.D., Hercules Powder Company, Wilmington, Delaware; EDWARD SHECKMAN, M.D., Stahl-Meyer, Inc., New York. The Board voted to hold the next Annual Meeting of the ACADEMY at the Netherlands-Plaza Hotel, Cincinnati, Ohio, February 15-17, 1956. Since the year 1956 marks the Tenth Anniversary of the ACADEMY, a special Tenth Anniversary program is to be arranged.

Pittsburgh Association

INDUSTRIAL MEDICAL ASSOCIATION OF PITTSBURGH, newly-formed IMA component society, held its first meeting at Mellon Institute, Pittsburgh, May 13, with 67 physicians in attendance. The scientific program met with enthusiastic response. J. HUBER WAGNER, M.D., President of the IMA of Pittsburgh, and Chief Surgeon, United States Steel Company, opened the program. He was followed by C. RICHARD WALMER, M.D., Managing Director, Industrial Hygiene Foundation, and W. S. McELLROY, M.D., Dean, University of Pittsburgh School of Medicine. A physician and a safety engineer took up industrial health problems in the making of glass. PAUL G. BOVARD, M.D., of Tarentum, Pennsylvania, discussed "Silicosis Problems in the Glass Industry," and MR. THOMAS R. DONOGHUE, Manager of Safety and Prevention at the Pittsburgh Plate Glass Company, talked on "Injury Exposures in the Glass Industry." Medical problems in the steel industry were discussed by E. A. McGOVERN, M.D., Jones & Laughlin Steel Corporation, Cleveland Works Division, Cleveland. HAROLD J. THEISEN, M.D., Cleveland, spoke on "Talar Fracture Subluxations." The morning session was followed by a luncheon attended by 40 of the physicians. FRANK E. GRAY, M.D., Westinghouse Electric Corporation, presided over the afternoon session. "The Role of the Biological Laboratory in Industrial Hygiene" was well defined by PAUL GROSS, M.D., Research Pathologist, Industrial Hygiene Foundation. A. G. KAMMER, M.D., Head of the Department of Occupational Health, Graduate School of Public Health, University of Pittsburgh, discussed "Ventricular Fibrillation Following Exposure to the Common Solvents." CAMPBELL MOSES, M.D., Director of the University of Pittsburgh's Addison Gibson Research Laboratory and Chief of Medical Clinics, presented a paper on "Current Concepts of Hypertension in Industry as a Guide to Treatment and Prognosis."

Minnesota Academy

MINNESOTA ACADEMY OF OCCUPATIONAL MEDICINE AND SURGERY held its Annual Meeting at Minneapolis, on May 25, 1955. H. W. LAWRENCE, M.D., Medical Director, Procter & Gamble Company, and Second Vice-President, INDUSTRIAL MEDICAL ASSOCIATION, presented the feature address. LESLIE W. FOKER, M.D., was elected ACADEMY President; JAMES ROGERS FOX, M.D., Vice-President; ORLEY W. FOSTER, M.D., Secretary; JOHN WILLIAMS, M.D., Recorder; TRACY E. BARBER, M.D., Treasurer.

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Physiology versus Pathology

IN THE literature of occupational health, there appears a fair number of titles embracing such language as "physiologic responses" or "physiologic action" in regard to toxic properties of divers industrial materials. An example may be found in the title: "The Physiologic Properties of Indium and Its Compounds." In the publication under this title the authors present extensive data describing the pathology of indium, including numerous autopsy protocols and photographs exhibiting organ damage. This use of language provides opportunity for questioning the propriety of describing toxic damage as physiologic. Just what is physiological? Where does pathology begin? Resorting to the medical dictionary, one definition of pathology is: "The branch of medical science which deals with disease in all its relations, especially with its nature and the functional and material changes caused by it." In that same dictionary physiology is defined: "The science which deals with living things, with the normal vital processes of animal and vegetable organisms." As to physiology, it is emphasized that the word "normal" appears in the definition, and as to pathology, equally significantly, the word "functional" stands out. On this basis, possibly it becomes an absurdity to incorporate under the conception of physiology all those changes resulting from the action of any industrial substances or, for that matter, any substances. Yet the practice is an increasing one, and possibly effort should be directed toward a sharper discrimination between those things that are physiologic and those other things that are pathologic.

In this perplexity, the guidance was sought of two physicians wise in the ways of semantics and philology — one a pathologist, the other a professor of preventive medicine. The pathologist directly is quoted:

"Science is becoming so specialized that whole categories of research workers seem to be growing up today who read only a limited set of journals and books restricted to their own specialty. They are bound to reclassify the well-known in their own terminology and it is not going to be easy to persuade the physiologists to call deviations from normal functioning, 'pathology,' as this runs counter to the general struggle for greater autonomy of the sub-specialties and the modern enthusiasm for the breaking down of scientific empires.

"About 25 years ago, I worked under a professor who classified all of medicine as a branch of anthropology. He was even inclined to embrace veterinary science as anthropology as it pertains to the welfare of the goods and chattels of man. His thinking was so logical as to be strictly useless.

"I share the view that pathology embraces all mechanisms of diseases and every demonstrable deviation from normality, no matter whether these observations are morphologically or functionally determined. Pathology cannot, however, be divorced from biology, physics and chemistry, anatomy or physiology. The true pathologist must also have a finger in the pie of clinical medicine, as his science interprets disease to the physician. The pathologist has, moreover, to take cognizance of man's total environment in order to track down the precise living, inanimate, cosmic or psychic etiological factors in disease.

"For a long time the anatomists have been muscling in on the domain of the pathologists and no great harm and perhaps a lot of good has come of it. Maybe we should accord the physiologists equal privileges. In the last analysis most pathological processes have no significance until function is interfered with.

"Obstruction to a bronchus or bronchiole may be anatomically apparent and the pathologist may speculate that because of its existence the appropriate lung component would continue to be properly perfused, but to no purpose, as it can no longer be aerated. The physiologists can prove this to be the case.

"Take also the question of cor pulmonale in silicosis. The pathologists never got further in explaining its genesis than to demonstrate vascular damage and to suggest capillary occlusion through distended alveolar sacs. The physiologists on the contrary showed that the pressure in the right side of the heart rises when the subject is caused to breathe air with a low oxygen content.

"It is going to be difficult to keep the physiologists from calling the foregoing processes 'physiological disturbances,' even when they are present along with anatomical abnormalities."

The professor of preventive medicine allowed no compromise. "Clearly the term 'physiologic' lamentably has been used when 'functional pathology' was the precise requirement."

IN AN earlier day, morphologic change governed concepts of pathology, and anatomical structures were the loci of alteration leading to diseases. That appraisal led to a scientific vacuum as to all those diseases unaccompanied by evidences of structural damage. No simple category existed for those diseases resulting from dysfunction of enzyme systems or of the endocrine organs. Biochemistry enormously has upset the earlier, well-defined partition between physiology and pathology. Now it is easy to locate such terms as "morbid physiology" or "pathological physiology." If physiology be accepted as the science of normal biologic functions, then the moment that normal functions are distorted to the point of detriment, pathology takes over so that conceivably the very notion of morbid physiology becomes untenable. Possibly the precise answer rests upon an acceptable definition of "What is a disease?" Who, anywhere, may provide any definition of disease acceptable to all?

To test this situation, these rhetorical questions were posed:

Is carbon monoxide poisoning a disease?

Is pathology involved?

Instead, is this merely a physiologic affront?

Is the entire matter one of degree, the initial stages representing morbid physiology and later pathology taking over the situation as severity increases?

Since carbon monoxide poisoning all too frequently is fatal, any insistence that carbon monoxide poisoning is not other than a physiologic process will have difficulty in acquiring support.

There is no better evidence of pathology than a dead man.

Bringing forth another example, let the early action of carbon tetrachloride in production of nausea and vomiting be appraised. It is granted that at this stage, carbon tetrachloride poisoning is but a functional disorder insofar as may be demonstrated. No cellular pathology may be disclosed through the most precise methods for morphological examination. Yet, if the full truth were known, it becomes a probability that the cells involved, without demonstrable morphologic change, no less are upset in their biologic economy through chemical alterations. Thus the point has been reached for the requirement of the acceptation of functional pathology without demonstrable morphologic damage.

WHEN Best and Taylor wrote "The Physiological Basis of Medical Practice" they were confronted with this overlapping of physiology and pathology which threatened any simplicity in the segregation of these two sciences. Promptly, they created opportunities for the clinical physiologists through the espousal of morbid physiology. To quote them: "Today, the student of scientific medicine is directing his attention more and more to the study of morbid physiology in his efforts to solve clinical problems. This newer outlook has borne fruit in many fields. It has had the beneficent result of drawing the clinic and the physiological and biological laboratories onto common ground from which it has often been possible to launch a joint attack upon disease."

All considered, it appears necessary in this changing world of the biologic sciences to accept the continuity of physiology into pathology and to break down the barriers that would deny any kinship between these two sciences. Still, in the orderly development of a suitable terminology applicable to the toxicology of industry—and, in truth, all toxicology—it may prove desirable to lean more heavily upon such terms as "pathology," "toxic," "functional pathology," etc., rather than to contribute to an enlarging confusion by describing toxic properties, tissue damage, disease states, as "physiologic" or "physiological," as did the authors above referred to when they wrote their report on pathology under the caption "The Physiologic Properties of Indium and Its Compounds."

APPLICATION FOR SPACE IN THE SCIENTIFIC EXHIBITS
1956 INDUSTRIAL HEALTH CONFERENCE
Convention Hall, Philadelphia, Pa., April 21-27, 1956

Application is hereby made to the Committee on Scientific Exhibits for space at the coming joint meeting of the Industrial Medical Association, the American Industrial Hygiene Association, the American Conference of Governmental Industrial Hygienists, the American Association of Industrial Nurses and the American Association of Industrial Dentists.

1. State exact title of exhibit suitable for the program and announcements:

_____

2. Description of exhibit. (A description adequate for the information of the Committee is necessary. From this, printed abstract for the program is prepared).

3. Exhibit will consist of the following (Check which):

Charts & posters	( )	Photographs	( )	Photomicrographs	( )
Roentgenograms	( )	Specimens	( )	Drawings	( )
Moulages	( )	Other material	_____		

4. The following equipment will be used (Check which):

Cabinets ( ) Viewing Boxes ( ) Microscopes ( )

Other equipment _____

5. Booth requirements. Please give space requirements so due consideration may be given your application by the Committee:

Length of back wall desired—Maximum: _____ Minimum: _____

Depth of Booth—Maximum: _____ Minimum: _____

Back and side walls for the booths and the maximum of two electrical outlets together with a table and two chairs will be provided by the Committee. Draperies, lighting equipment and additional furniture must be provided by the exhibitor.

Date_____, 19____

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(FULL ADDRESS) (INSTITUTION OR COMPANY)

NAMES AND ADDRESSES OF CO-EXHIBITORS (If any):

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News, Comment, Opinion

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—SRDS Business Publication Research Report No. 32.

"Visually Unqualified"

FOUR out of 10 industrial workers are "visually unqualified" for satisfactory performance of their jobs. This was one of the conclusions of a recent Bausch & Lomb Optical Company eye research project involving 12,000,000 industrial workers.

—*Worcester, Massachusetts, Telegram*, May 11, 1955.

"Look About You"

IN MY OPINION, to date we have chipped away a few fragments from the Mountain of Knowledge—fragments that have changed our entire way of life. But looming ahead of us, practically intact, lies a huge mass of fundamental facts any one of which, if uncovered, could change our civilization. In that mountain lies the solution to the problem of how we can utilize the practically limitless energy of the sun pouring down on the earth, and there also is the answer to the age-old problem of feeding the millions of undernourished people in the world. Somewhere in that mass are the cures for cancer, the common cold, and other ills that beset the human race. Just out of reach there, today, is the design for a successful interplanetary space ship. And I am sure someone, on the most important date in the history of mankind, will find there the answer to world peace.

—From "You Haven't Seen Anything Yet," by CHARLES F. KETTERING, in *The Foundation*, publication of the Engineering Society of Detroit, June, 1955.

Reprints Available

INDUSTRIAL HYGIENE FOUNDATION, has available, for free distribution on request, the following reprints: "Permissible Dustiness" by THEODORE HATCH; and "Partitional Respirometry" by THEODORE HATCH and KENNETH M. COOK. Address Industrial Hygiene Foundation, Mellon Institute, 4400 Fifth Avenue, Pittsburgh 13.

On Noise

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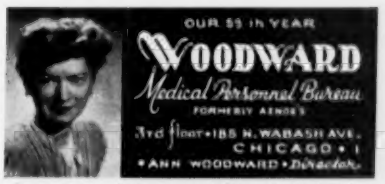

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Medical Director: (b) Board internist; well qual cardiology; able organize, direct any size med care program; 6 yrs, plant phy and currently ass't med dir, impor Co. late 30's.

Assistant Medical Director: (c) Outstanding yng man inter'd, indus med as career; finishing wk lead'g to Doctorate, Indus Medicine; past yr, indus res one of finest indus medical programs in America, early 30's, recommended as exceptional man with great potentiality.

Industrial Physician: (d) Exceptionally well qual as ass't for lge multiple plant operation; M.D., Cincinnati; trn'd internal med; sev yrs surgical exper; 3 yrs, successful priv pract; 4 yrs plant phy & medical dir medium size plant; now earning $14,000; prefers Mich, Ohio, Ind, well qual EKG, middle 30's.

Staff (e) 3 yrs res, internal med, univ hosp; 2 yrs, med office, ammunition depot; inter'd indus hygiene; cat IV; late 20's; serious ygn doctor, immediately available.

Staff: (f) Indus phy, sev years, one of finest med facilities of lead'g Co; Medical degree, Harvard; pref N.Y., N.J. Penna; age 30.

Staff: (g) Board clig Internist; Class "A" school; sev yrs successful priv gen pract; inter'd indus med as career; age 30.

Staff: (h) 3 yrs exper as indus phy; sev yrs, res, gen'l & orthopedic surg; prefers Pacific Coast; early 30's.

Staff: (i) 6 yrs, successful priv gen'l & surgical pract; prefers indus med with regular hours; early 30's; Cat IV; Class "A" grad.

SITUATIONS OPEN

Medical Director: (g) One of leading companies; vicinity Los Angeles; req's man with exper, inter'd in indus med as career.

Medical Director: (r) Preferably with exper in medicine; lge plant, division of major company; Gulf Coast area.

Medical Director: (i) One of finest indus programs; dept well staffed & equipped; excel policies; 2000 empl; warm year round climate; smaller res town; $12,000; SE.

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Staff: (k) Indus clin, major Co; 14,000 empl; $12,000; lge city, univ med center; MW.

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ployee Relations Division, has issued an information bulletin on noise. The emphasis is on the steps that may be taken by an individual company to protect itself and its employees. This bulletin may be acquired at the cost of 20 cents; the Association may be addressed at 2 East 48th Street, New York 17.

Not Money, But Health

PHYSICIANS feel that any financial advantage that might accrue as a result of an adequate medical program should be considered a by-product, for the main purpose of good medical services is not to make money but to make health. However, industrial medicine does save funds in the following ways: (1) prompt treatment prevents infections and other complications, thereby shortening the length of the disability; (2) it helps control medical, hospital, and insurance expenses; (3) good medical care is more economical than high compensation payments and settlements; (4) healthy workers are more productive; (5) costly disabling injuries and diseases are prevented before they occur; (6) it decreases absenteeism from illnesses non-occupational in origin; (7) it helps prevent the loss of management persons through illness or emotional failure.

—From "Medicine in Industry, by HAROLD A. VONACHEN, M.D., in *J.A.M.A.*, April 30, 1955.

Crisis to Crisis!

AMONG the contributory causes for increased mental illness we may cite several devastating wars; a series of economic depressions; great fluctuations in what a man's wages would purchase; great wealth and great poverty in the same precinct; a breakdown of cohesion in some families with resultant loss of security, affection and love; the spreading of false alarms by way of newspapers, radio and television; too much publicity to the mutterings of misguided persons, self-appointed prophets, demagogues, ambitious and ruthless politicians who would climb to eminence over the disturbed minds of their fellowmen; and captive economists hired by pressure groups, including some corporations and some unions, to disseminate fallacious economic theories and the mouthings of other small men. On occasion we seem to have been living from one crisis to another. Danger is said to assail us from many quarters, and some of these hazards have been real enough to make a strong man quail. Fear, frustration and feelings of insecurity develop beyond proper proportions. Stress, apprehension, hostility and aggression are the natural psychological reactions to such a conditioning process. All this is reflected in the rising burden of mental illness that is becoming a modern national problem.

—From "Geriatrics and the General Practitioner," by CHARLES SELLERS, M.D., in *J. Michigan State Med. Soc.*, May, 1955.

Socialism—A Fraud

THERE are 400,000 workers in the British National Union of Railwaymen. When they voted for public ownership of the railroads they fully expected to see their wages rise beyond those of railroad workers in America. But after nearly 10 years of public ownership of the railroads, they have come to a point where they must make themselves satisfied with wages

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ranging from $18 to $26 a week and call off their scheduled strike. The details show that socialism is a fraud when it says that public ownership creates a "workers' paradise." After two years of negotiation, the government has agreed to raise the wages of the low-level employees from $17.50 to $18.34 a week, a week's increase of 84 cents, or 16 cents a day. The highest paid railroad men, the engineers, receive $25.50 weekly, and their raise will be a few cents a day more than that given the lower rate employees. The union has accepted this settlement. American railway workers receive wages which are, on the average, about three to four times higher than those of their counterparts in England. And thousands of the skilled engineers on our modern trains get 600 to 800% more than the English engineers who are living and working in their "workers' paradise" of public (or government) ownership. The record speaks for itself and is living proof that the "free enterprise system is the better way of life."

—*Arizona Medicine*, May, 1955.

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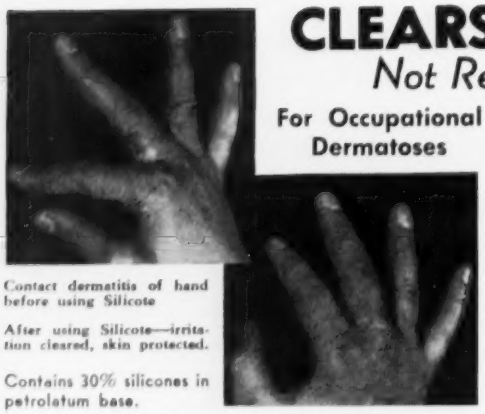
In Iowa

SINCE 1945 many industries have located in Iowa. In 1953, when, for the first time, the income from industry exceeded that from agriculture, it became apparent that industrial medicine had become really important and deserved more consideration than it had received in the past. This influx of industry has created many problems — medical, economic and social. It is not our intention to discuss more than the medical phase, although inevitably it has posed all of the others as well. The more workers in a plant, the more medical problems arise. There are always accidents to be considered, and working conditions may create health hazards. Dust, noxious fumes and excessive heat are but three among many. In areas that have been industrialized for a long time, it has been common practice to have a Medical Director in the plant. Here in Iowa we find that there are only six full-time industrial physicians, providing medical coverage to eight companies. They are paid according to a variety of plans, by salary, by fee bill, and (two of them) by a combination of both. Of the physicians replying to the questionnaire, sent to the membership of ISMS by the Committee on Industrial Health, 466 said that they do some industrial work. Of these, 29 are on a salary, and 425 are paid on the basis of fee for service. Naturally, many of these physicians give medical care only in their offices or in hospitals as patients are sent to them from the plants. In some instances, of course, they are called to the plant to handle emergencies, but it was somewhat surprising to find that only 78 of the 466 physicians spent a definite amount of time per week in the plants they serve. These 78 reported that they spend 420 hours in-plant, or a little over five hours per week. It has been the feeling of the Committee, most of whom do some industrial medicine, that it is most important that a physician spend some time in the plant, even if no more than an hour a week. Only by so doing will he gain a true picture of working conditions and be able to make recommendations for improving the health stand-



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1. Talbot, J.R. et al: J. Inv. Derm. 17:125
2. Morrow, Grant: Calif. Med. 80:21

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ards. Many physicians did not report on the number of companies they served, probably because they give care only when patients are sent to their offices. Of the total, however, 224 reported that they served 903 companies. Some said only that they served many companies. Forty-nine doctors reported that they had industrial nurses working under their direct supervision, the number of nurses being 150. Of these nurses, 119 worked full time in the plants, and six divided their time between one or more plants. The balance, it is presumed, worked part time only, and for one plant. Thirty-three physicians reported that they knew of plants employing industrial nurses who worked without any medical supervision. In the opinion of the Committee, the ethics of such a medical program may be open to question. One hundred sixty-one physicians answered that they did not know of any nurses working without medical supervision. There seemed to be a variance of opinion on the question of whether more industrial nurses are needed, 47 physicians feeling that the need is not being adequately met, and 174 that there are enough nurses doing that sort of work. The answer as to what percentage of the doctor's service is given to industrial medicine was vague in many instances, many physicians saying that only a small part of their time is spent on such patients, and some admitting they didn't have any idea about the percent. Of the replies, 432 physicians gave figures, and the average came to about 8.5%. In 82 replies, the doctor said he used an industrial fee bill, but 237 said they did not. Almost all of the replies indicated that fees for industrial work were about the same as those paid in private practice. In 377 tabulated replies, the average of the work that was covered by insurance was 88.5%. Very few physicians reported having any difficulty in collecting. Several times in past years, the House of Delegates of the State Society has been asked to consider establishing a fee schedule that could be used, among other things, for compensation cases. To date no such request has been considered favorably. The Committee was interested to find that 163 physicians felt such a state-wide industrial fee bill would be helpful, if set up by the State Society, and 132 felt it would not be. Another facet of industrial medicine that has been discussed at great length by the Committee is the relationship existing between plant medical services, whatever they may be, and the physicians engaged altogether in private practice in the community. A proper program of good industrial medicine should never infringe on the private practice of medicine, and it is essential that there be close cooperation between local physicians and the men serving as medical consultants or directors in industry. On the questionnaires, the replies from 354 physicians said such cooperation existed, whereas only 24 said it did not. Absenteeism is one of the biggest problems faced by all industry today. Ideally, a good medical program in a plant should be able to reduce that difficulty by prompt attention to small injuries as they occur so that subsequent infection and disability may be prevented and so that illness, when it occurs, is discovered promptly and is referred to the patient's family physician. On his part, the family physician who has a good knowledge of the type of work done by his employee-patient will know better when he can return to work, and when he should not be on the job. Of the physicians replying to the question as to whether absenteeism could be reduced by an organized closer association between private medicine and the plant medical office, 213 said yes and 81 said no. Two hundred sixty-five physicians were interested in expanding their industrial work through assistance to small industries in their community, and 110 were not. Only 83 physicians reported they were members of industrial medical societies, and 370 said they were not. Sixty-four said they attended industrial meetings, and 197 said they did not. Two hundred sixty-three reported they would be interested in a one-day meeting representing management, labor, industrial physicians, general practitioners, and other industrial and public health workers, and 115 said they would not be. One of the most interesting things of the whole survey was the fact that 353 physicians doing industrial work asked for a summary of the answers. Of those who did no industrial work, about 50 or 75 asked for the summary anyway.

—From an Editorial, in *J. Iowa State Med. Soc.*, June, 1955.

The Workman's Heart

WHEN a worker dies of heart failure, what killed him? Was it his job? Or his diet? Or the kind of life he led when not working? Or was it the culmination of a degenerative process that would have resulted in death at just that time whether he had been working or not? These are knotty questions that concern a knotty problem this state (and other states) must presently face squarely. For the present trend in workmen's compensation settle-

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1. Vainder, M.: Indus. Med. & Surg., 22:183, 1953

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ments is rapidly making a macabre joke out of the law that was designed simply to protect the worker from injuries resulting from his job. The law is now becoming what it was never intended to be, public health insurance against degenerative diseases. And it is operating to bar from employment anyone with a heart condition. Dr. Richard J. Clark, who directs the cardiac work of the Bay State Rehabilitation Clinic, writes a significant article with two co-authors in *New England Journal of Medicine*. They point out that judicial decisions have introduced a completely new philosophy in employer responsibility. Take a recent decision (January, 1954). This concerned the death of an inspector for the Registry of Motor Vehicles who died of a heart attack after investigating an accident involving the possible suicide of a woman he had known personally. The Supreme Court, in upholding the Industrial Accident Board's decision in favor of the compensation claim, held that the strain of distress, worry, fear or anxiety is just as much a strain on a weak heart as physical exertion. The inspector was stricken, it appears by a job-induced emo-

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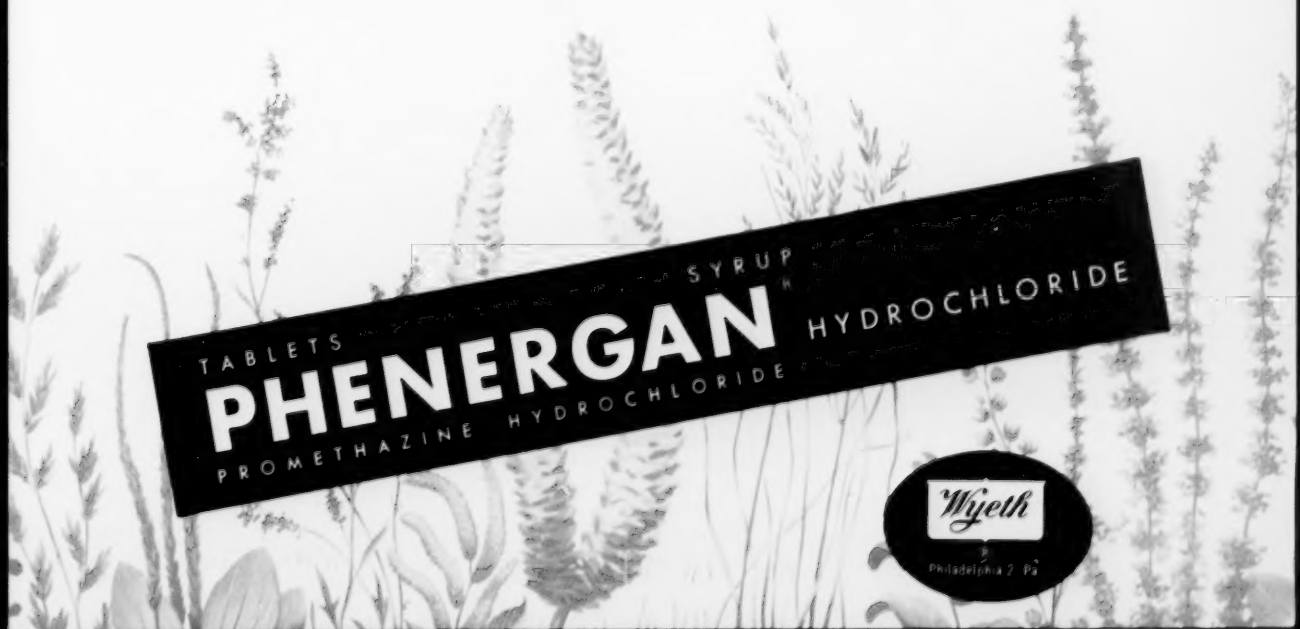
"... results obtained with PHENERGAN in symptomatic relief of pollen hay fever were far superior to those obtained with any other antihistaminic agent."[1]

1. Silbert, N. E.: Ann. Allergy *10*:328 (May-June) 1952



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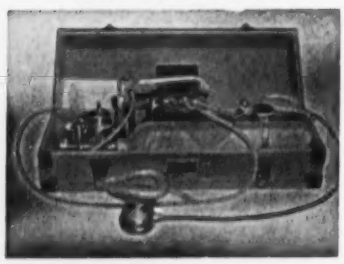

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tion. The calculation of physical strain is difficult enough; to measure emotional strain is quite impossible. No man is free of worry. Yet that becomes a factor on which settlements of $10,000 or more depend. Dr. Clark and the others point out that half of all men suffer from a significant degree of coronary narrowing and blocking by the age of 45 to 50. It appears to be the inevitable lot of man. But it does not appear that work is bad for such men. Studies have shown that men 45 to 64 years of age doing heavy work are somewhat less than half as likely to die from coronary-artery disease as those doing light work. And those who continue active work, (such as postmen delivering mail), are somewhat less than half as susceptible to sudden fatal coronary occlusion as their white collar associates, the postal executives. Maybe physical exertion over the years acts as a protective mechanism. What this means is that the very job that may have prolonged a worker's life is blamed when he finally dies. It means that the job is blamed when diet (an excess of fat) is more likely the cause of death. This makes of workmen's compensation a sort of general compensation for heart disease. It is a burden of expense that this insurance ought not to bear and cannot for long. In 1949 heart cases were 19.7% of all fatalities on which claims were paid. In 1952, heart cases had risen to 36.9%. In those four years the cost of heart fatality compensation rose from $269,000 to $689,000. In the meantime, employers must, for their own financial salvation, refuse employment to those with heart defects, or even those of advancing years. It is one of the tragic consequences of this perversion of workmen's compensation that the rehabilitation of persons with heart ailments has been made extremely difficult. There are few jobs for them.

—*Boston, Massachusetts, Herald*, March 31, 1955.

What Makes An Executive?

"WHAT MAKES an Executive?" found few pat answers from executives in business, government, military service, education, religion and medicine who took part in Round Table on Executive Potential and Performance, conducted by Columbia University Graduate School of Business. But participants agreed man must possess at least these qualities, if he hopes to become executive: He must have physical and emotional stamina to maintain grueling pace of executive leadership. He must be willing to make personal sacrifices — time with family, personal popularity, hobbies, etc. He must be willing to take risks — to move from one place to another or to switch jobs in mid-career. He must have strong, continuing drive or ambition. While college degree was acknowledged by conferences to be logical as preliminary screening device in selecting potential executives, it was also emphasized over-reliance on degree is impeding discovery of many men of high potential. Superiors likely to rate men working for them with some degree of bias, whether high evaluation of subordinates constitutes threat to themselves, many participants felt. They thought system of multiple rating produced more objective picture. Too much emphasis on promotion and not enough on doing present work better is tendency in executive development programs.

—*Industrial Relations News*, June 11, 1955.

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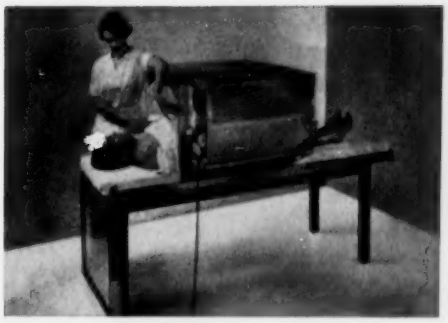

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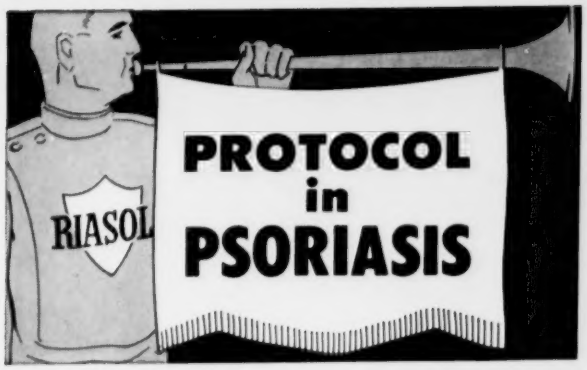

PROTOCOL in PSORIASIS

In a recent article in the British Medical Journal, Ingram* emphasized three important points: (1) The disease is milder in summer. (2) Psoriasis is esentially an epidermal reaction and hence should receive local therapy. (3) Treatment must be continued until the skin is clear; not a single active lesion can be left if extension is to be avoided.

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*Ingram, J. T., Approach to Psoriasis, British Medical Journal, 2:591, 1953.

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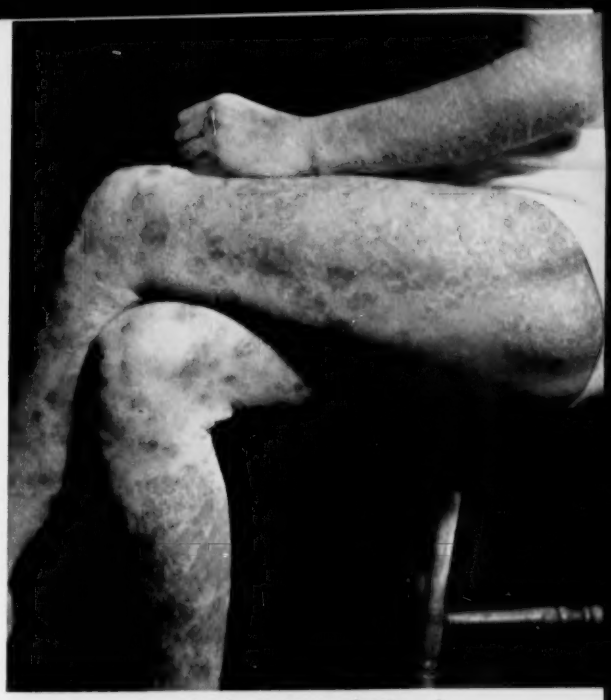

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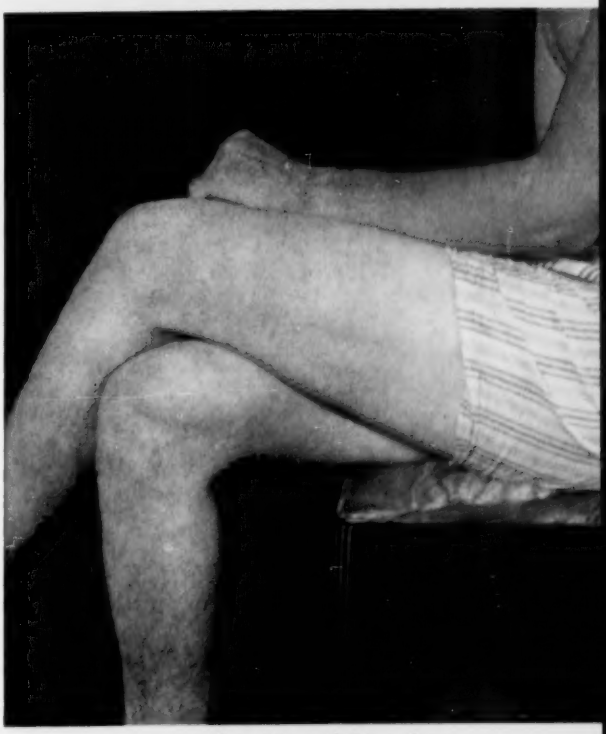

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References: 1. Indust. Med. 20:480, 1951. 2. J.A.M.A., 158:386, 1955.

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